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SCIENCE FICTION AND FACT

FEBRUARY 1996

HIGHER EDUCATION

by Charles Sheffield
& Jerry Pournelle

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SCIENCE FICTION AND FACT



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BY BREAD ALONE

If you read *Analog's* double issue last month, you saw Tom Easton and Steve Gillett's "debate" on population and the future. In case you missed it, Tom argued, in essence, that the human population of Earth is very likely headed for a catastrophic crash within the next century or so because it's growing at a rate that food production can't be expected to keep up with. Steve took a more optimistic view, citing reasons for viewing the present high rate of population growth as a temporary aberration that will likely correct itself before things get that bad.

It's possible for two intelligent, educated people to have such different views because predicting the future involves guessing at variables that can't be known in advance. Those uncertainties make still other views just as defensible.

There is, for example, a fellow somewhere in the Midwest who's been doing a lot of detailed, thought-provoking speculation and distributing it to people who might be interested, identifying himself only as "Midwest Amateur Futurist" or "MAF" (You may remember him as the inspiration for a recent *Analog* article by

Dr. Gregory L. Matloff.) One of his essays describes a possible method for feeding a vastly larger population than that we now have. His view is a sort of opposite to that in Tom Easton's essay last month. Easton assumed no radically new food production technologies; MAF assumes that such are both necessary and possible.

Some highlights of his argument (which he has explicitly placed in the public domain): "There is a desperate need for new food sources unaffected by vagaries of traditional crop harvests. . . . The population of the Earth currently doubles in about 40 years. . . . At this rate . . . by 2600 A.D., there could be about 212 trillion people. . . . This implies starvation on a scale never before seen, if we do not find a way to feed the people soon to be born."

He then proceeds to suggest, in considerable detail, such a way. "It appears that, by mining the moons of the planets of the Outer Solar System, and, eventually, the planets Jupiter, Saturn, Uranus, and Neptune, for their deuterium, enough deuterium can be found to support recycling of sewage hydrocarbons into SCP (single cell protein) feedstock to feed an ex-

nentially expanding human race (40 year doubling time) until . . . 1,175 years from now. . . . [MAF acknowledges that the idea of getting SCP from extraterrestrial sources was earlier suggested by Neil P. Ruzic in his book *Where the Winds Sleep*, published by Doubleday in 1970.] This is possible with technology very little better than that available in 1994. . . . The key technologies are fusion bombs, electrolysis, methane synthesis, and formose (sugar) synthesis . . . all technologies available in the late 20th century."

My personal suspicion is that the political obstacles between present reality and that future vision are bigger than the technological—but let's suppose, for the sake of argument, that both technological and political problems can be solved. Maybe we *can* develop practical ways to support huge populations for a long time. But even if we can, *should* we?

Both Easton and MAF base their arguments on their own views of what can be done by way of increasing food production. Certainly that's an important consideration, particularly if Easton's projections are closer to the truth. If food production *can't* keep up with population growth,

then either the standard of living must decline, perhaps eventually leading to a catastrophic collapse, or people will have to find ways to keep population growth from increasing faster than food production.

On the other hand, if MAF's view is closer to reality, then population growth shouldn't be a problem, at least for the next thousand years or so. After all, if we can feed everybody, everything's peachy. Right?

Wrong.

What too seldom gets mentioned in discussions of this matter is an important fact well summed up in an old cliché: Man Does Not Live By Bread Alone.

Food isn't everything. We may be able to feed and even house a very large number of people on Earth—perhaps even 212 trillion—but if we do, none of them are going to have much *fun*. Every part of the planet will be jam-packed with either people or things dedicated to feeding people. Too much crowding isn't good for people. If the state of our cities is any indication, it's downright dangerous.

Pack too many people too close together and you start getting effects a little like packing too many uranium atoms too close together. Too much

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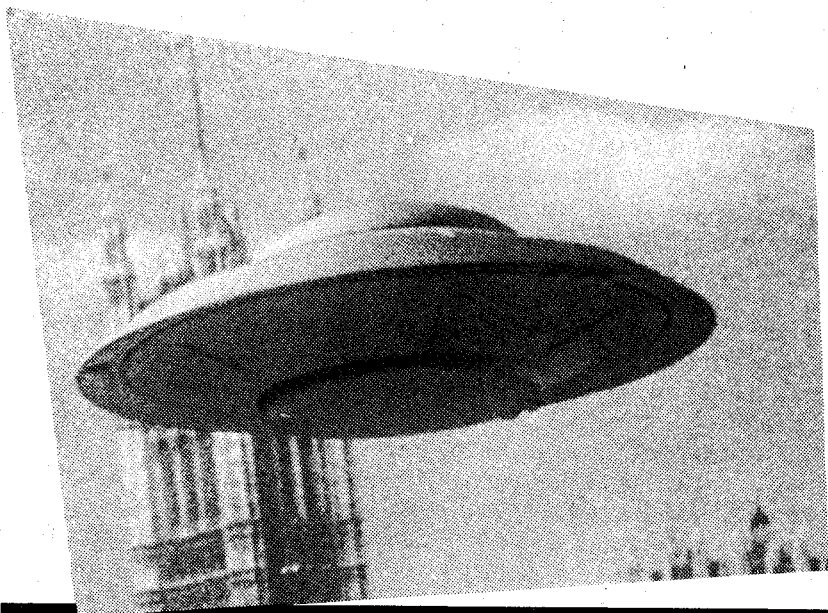
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cides who will be forcibly deported?

Some have suggested that virtual reality could provide a way to accommodate very large populations while preserving the feeling of freedom and elbow room. The idea is that people can lie around in boxes and be kept entertained with the perpetual *illusion* of an ideal world, which doesn't require much room. That might satisfy some; but for some of us, who consider even the most convincing illusion to have important fundamental differences from reality, it wouldn't even come close. We would be perennially nagged by the question, "What's the point?"

Still another possibility is one suggested, I suspect with tongue deeply in cheek, in Andrew Offutt and Richard Lyon's novel *Rails Across the Galaxy* (*Analog*, August through Mid-September 1982). You can have more people on Earth at one time if only some of them are up and about—so you put most of them in cold (cryonic) storage, and have them take turns. But how likely is it that those who are currently conscious and enjoying themselves will cheerfully go into the fridge for a few decades to give somebody else a chance?

All such suggestions that I've heard seem to me, at best, stopgap solutions—unsatisfying dodges to avoid facing the real issue. Both MAF and Tom Easton make a key assumption that I cannot accept: that we must accept rampant population growth as inevitable and either suffer the consequences or find ways to feed those hordes. They support this assumption with the observation that, so far, ef-

forts to control population growth have not been very successful.

But that doesn't prove we can't learn to do it better in the future, and I submit that we must. (Steve Gillett thinks we will in the ordinary course of events, but I think it may take more deliberate effort. He says people are very good at acting in their own best interest, but I'm not quite so optimistic about that. It seems to me that people are very good at acting in what they *think* is their own best interest, but less so at accurately determining what *is* in their own best interest—especially when that involves large-scale factors that are not obvious at the individual level.)

Merely *feeding* vast hordes is not enough to insure that their lives will be satisfying, or even worth living. They also need at least a modicum of breathing room, variety, and personal freedom. All of those get harder to provide as the population grows denser.

Providing food for an arbitrarily large number of mouths is not enough. Quality of life—and I'm *not* just talking about material wealth—is important, too. Naturally we should do what we can to meet the physical needs of however many people exist. But that's not the only variable in the equation, or even the only one we can control.

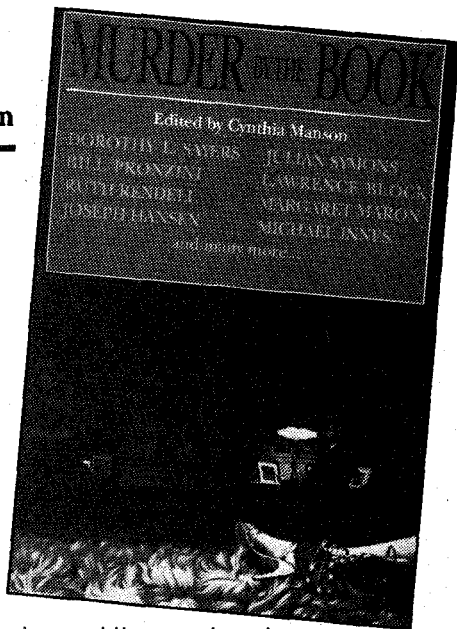
At some point, the inhabitants of any world, if they're at all concerned about *quality* of life, will have to address the problem of population growth not simply as a matter of how to feed them all, but of taking responsibility for deciding to stop making so

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many. In many parts of the world, many people already do this at the individual and family level. They call it "family planning." You *choose* what kind of life you want to give your family, and how many you can give it to. Then you have that many, and no more.

We need family planning on a worldwide level. This does *not* necessarily mean a worldwide dictatorship imposing its rules on people's most private behavior. A better way to do it—admittedly an enormous challenge, but not one that should be shirked because it's hard—is through education. The actual decisions can still be made within individual families—if enough families have learned to think beyond their own four walls in considering the effects of their decisions. However it happens, the human family needs to recognize that it has a *choice* about how big to become, and that choice will affect how everybody lives. Do we really want ourselves and our descendants to live poor, crammed together, and con-

stantly at each other's throats? Or do we want them to have full stomachs and enough breathing room to enjoy each other's company rather than fearing it?

If your world is filled to whatever you consider its capacity, any more you make will *have* to be shipped elsewhere. Even if you have the technological ability to do that, they might not want to go; and the inhabitants of the other places you might put them will be multiplying, too. Even MAF, after detailing a plan for feeding vast numbers of people in the next few centuries, talks about "If mankind's numbers can be stabilized by then. . . ." But he does not address the question of why or how that will happen then if (as he seems to assume) it can't happen now.

The question can, perhaps, be postponed; but it cannot be avoided indefinitely. Sooner or later the human family, regardless of available resources and level of technological prowess, will *have* to get in the habit of practicing restraint. ■

(A Personal Note to MAF: Thanks for the food for thought. Now, why not come forward and identify yourself? It would be nice to be able to communicate both ways!)

MOVING?

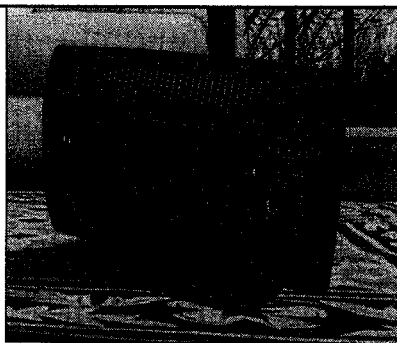
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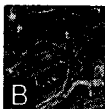
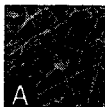
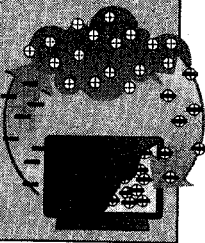
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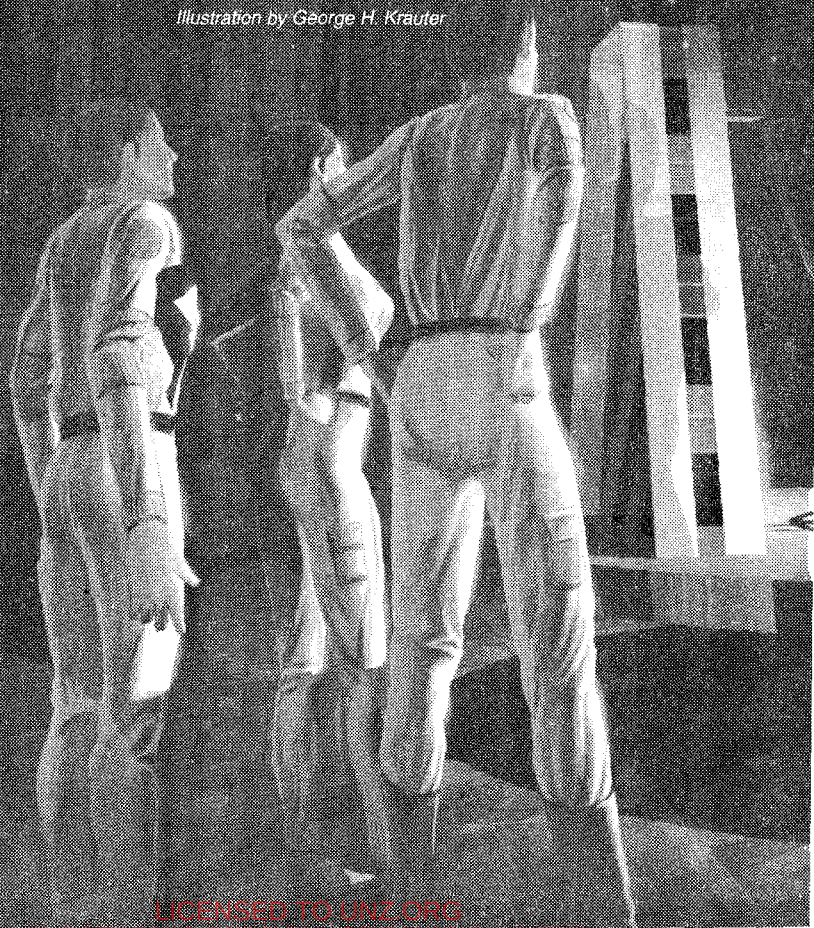
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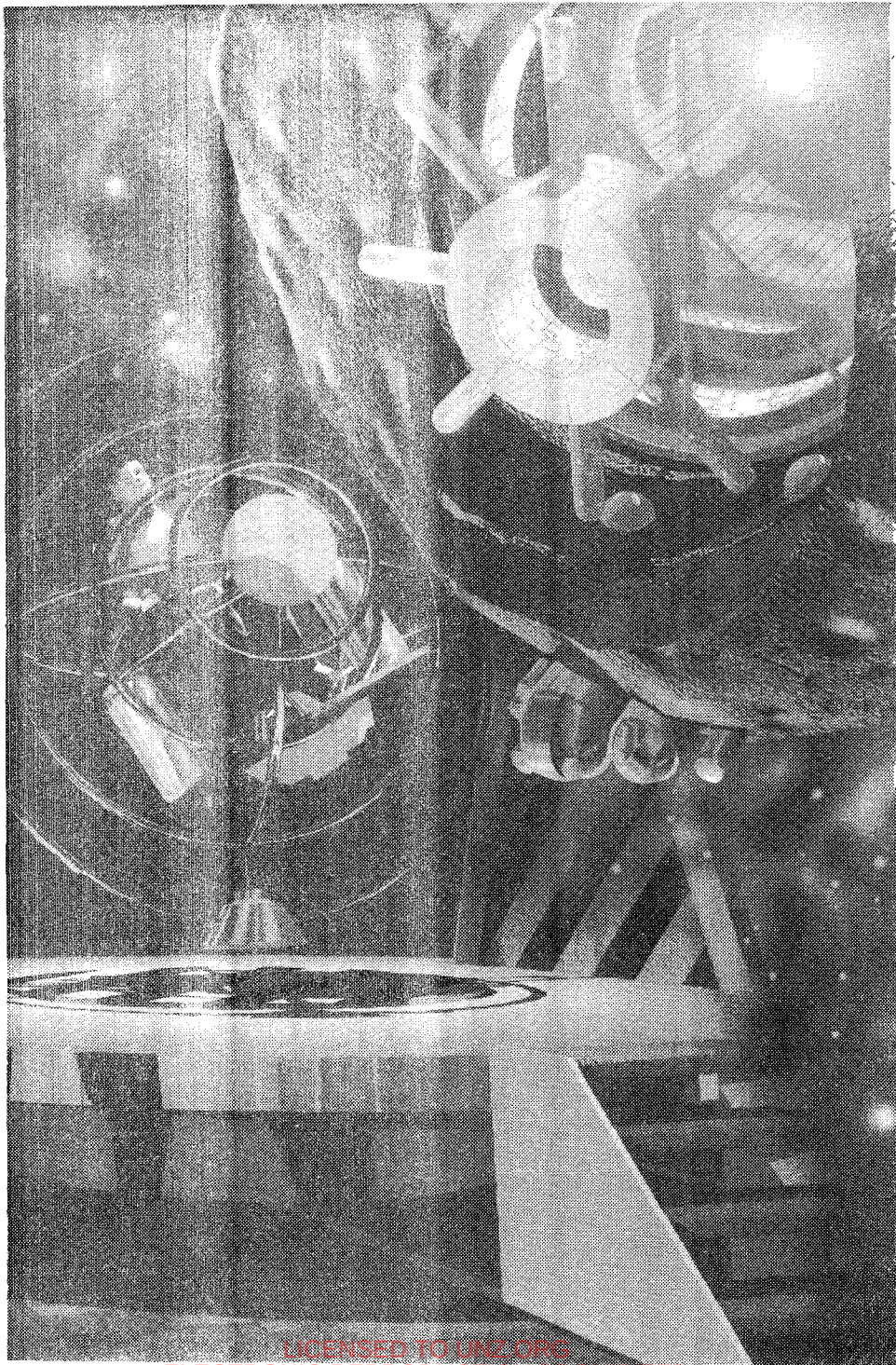
HIGHER EDUCATION

*It's not always easy to tell whether
you're in the frying pan or the fire. . . .*

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Part 1
CHAPTER ONE

At sixteen, Rick Luban's life was about to end. He didn't know it yet. He thought he was all set for a good time.

The first period had gone no differently than usual. Mr. Hamel had been teaching high school for thirty years—forever, in Rick's eyes. Hamel looked like an old turtle, and like a turtle he had developed his own survival techniques. Nothing got to him; not talking in class, or eating, or farting, or sleeping. Gross and direct rudeness or violence, too much even for him to ignore, he passed up the line at once to the principal's office.

Hamel's rule: No fuss, no muss. And if that meant no work and no learning, too, he would settle for it. He usually reached that understanding with a class before the end of its first week.

"Test today." Hamel took no notice of the half-hearted groans. Failing an Act of God, biology tests in his class came every Tuesday and everyone knew it. "Read the questions, mark the answers. You have forty minutes."

More out of boredom than anything else, Rick put on the earphones attached to the desk and slipped the written sheet of questions into the reader.

"Question one," said the voice in his ear. "Five point credit. One of the animals on your screen belongs to a different class from the others. Indicate which one. For assistance on the biological definition of *class*, or for name identification of any of the animals shown, touch the empty box."

The TV screen in front of Rick was

divided into six rectangles. The first was empty. The second through sixth showed an ant, a butterfly, a mosquito, a spider, and a caterpillar. They were all in color, and all moved in natural settings.

Rick saw Dim Willy Puntin, Puntin the Pumpkin, reaching out to poke the icon of the caterpillar. It certainly looked grossly different from the other four. Rick snorted to himself. That was just like Hamel, trying a trick question. Rick had hardly been listening to the lesson about larval insect forms, but even a five-year-old knew that caterpillars turned into butterflies; and insects all had six legs.

Rick reached forward to touch the icon of the spider, at the same moment as Juanita Cesaro, two seats in front of him, removed her headset. She raised her hand and then stood up.

Hamel left the raised podium and moved over to her at once. Rick eased the earphones away from his head. Juanita was dim, but she was hot stuff. Half the boys in her year—including Rick—had been through Juanita; but you'd never know it from seeing her in class. She always sat demure and quiet, doing so poorly in every subject that her teachers all had trouble passing her. She never caused trouble.

"These." Juanita waved her hand vaguely at the headset, television, and reader. "Not working."

Hamel came around the desk and leaned over to examine the television picture. He was very careful not to touch Juanita, and careful to stand so that this fact would be apparent on the classroom videocamera recording.

Wily old turtle. No sexual harassment charges for you. Rick could see the empty box and the five icons on Juanita's screen, just like on his own. Another clapped-out reader, it had to be. The readers were junk, breaking down all the time. Even when they worked they would only handle one size of page. School was too cheap to buy decent stuff. Not like the school the phone company ran. That place had great equipment, but it was just for kids whose mothers or fathers worked there. His mother had gotten herself fired for drugs six weeks after she started with them, so Rick had only been to company school for a little while. That was back in first grade, but he still remembered it well.

Hamel had apparently made up his mind about the reader. He was glancing thoughtfully around the class, finally gesturing to a girl at the back. "Belinda. For this period I want you to change seats with Juanita."

Rick had expected that action, well ahead of the teacher's taking it. Belinda Jacob was one of three people in the class who could read well enough to handle the test from the printed sheet, without using a reader at all. *So see what reading does for you*, Rick thought, as the two girls changed places. *Not a damn thing.* Belinda was Hamel's star student. She had probably been halfway through her own test before she had to move—and now she was forced to start over, while Juanita would get the benefit of her right answers.

Rick grinned to himself as he settled back to listen to the rest of the questions. Unless Hamel went to the trou-

ble of noting the point where the two had changed over, which wasn't at all likely, Juanita for the first time in her life was going to score—on a *test*.

The broken reader was all that the first period could offer to relieve the boredom. That was predictable with Mr. Hamel. Dullness was the rule. What Rick and his friends had been looking forward to for a week was second period. They were supposed to get a new civics teacher then, right out of training.

"Willis Preebane, his name is. An' if I can't have some fun with him, I'm losing my touch."

Screw Savage was speaking. Any one of the three might have offered the same statement, but Screw had special credibility. He was a school legend. Two years before, by a mixture of near-inaudible insult and off-videocamera dumb insolence, he had made a new teacher take a swing at him on her very first day. She had been fired on the spot. Screw was provided with a groveling apology from Principal Rigden. His parents had sued school and county anyway, and been paid a hefty out-of-court settlement. Now Screw tended to get high grades without ever doing homework or handing in tests.

"But we'd all like to have first go at him," Screw went on, "so we do it fair, an' draw lots."

Rick and the other two were walking between classes, heading for Room 33 with Screw Savage leading the way. The corridors were their usual confusion with backed-up lines in front of the metal and plastique detec-

tors. Hoss Carlin, walking next to Rick, took a step to his left and reached out to brush his fingers over the breasts of a girl walking the other way. She slapped his hand away, but she turned to give him a big smile and said, "See you tonight."

"Watch it, Hoss," Rick warned. "You're in deep shit if they have that on camera."

"Nah." Hoss jerked his head upward. "Checked already."

The ceiling videocamera for the corridor was ruined, lens broken and body a shattered hulk. It was like this all over the school. Every time a corridor camera was repaired, within a day or two it would be smashed.

"Anyway," Hoss went on. "Jackie'd be on my side if they did see me. She'd tell 'em I was swattin' a wasp off her tit or somethin'."

The three youths were almost at Room 33. Most of the class was already there, standing waiting outside the locked door.

"Mebbe Preebane's not as dumb as you think, Screw," Hoss said. "He knows at least that much. Lockin' the door stops us from givin' him a welcome."

"So one of us has to get real inventive once we're inside." Savage turned around, three toothpicks sticking up from between the knuckles of his closed right fist. "Short one has first go at Papa Willis. Who wants first pick?"

"Me," Hoss said, and grimaced with annoyance when the toothpick he pulled was full length. "Lucky with women, unlucky in the draw. Go on, Rick. You got one out of two chance now."

Rick plucked the toothpick from between Savage's first and second finger, and grinned when he saw it was a fragment only an inch and a half long.

"Lucky bastard." Screw opened his hand to reveal a third, full-length toothpick. "You get Preebane all to yourself."

"Aha!" The voice, thin and with a definite lisp, came from behind Rick. "And do I hear thomeone taking my name in vain?"

Rick turned and stared. The man waddling along the corridor was too good to be true. He was pale, short, and grossly overweight. He had watery blue eyes in a pudgy face, and he sported a flat, gingerly-brown moustache that looked as though it had been poorly dyed and pasted above his full upper lip.

Preebane's very appearance was an opportunity to have fun. If Rick didn't get in quickly, some other class joker certainly would.

In fact, it was already happening. Rick heard a whisper, deliberately loud, from among the group of waiting students: "Quiet now. Here comes our new PE teacher."

Preebane, heading for the classroom door, paused uncertainly. After a moment he decided to pretend he had not heard the comment. He unlocked the door and waved the students inside. Rick, contrary to his natural instincts and usual practice, went to sit in the middle of the first row. Preebane, belly wobbling, moved to stand beneath the videocamera right in front of Rick. He beamed directly at him.

Rick gazed back and waited for in-

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spiration. He, who usually had a thousand ideas for baiting teachers, suddenly found his mind a blank. Goaded to physical violence, Willis Preebane looked like a man who would drop dead from the exertion before he could land the first blow.

And that voice. "Good morning. I am Mr. Preebane, and I want to welcome you to my class on introductory civics." Or rather, it was "Mr. Pweebane," and "my clath on intwoductory thivich."

"I told Pwinthipal Wigden of my ap-pwoach, and she agweed with it completely. Begin by forgetting evewything that you have ever been told about the Conthititution."

"Done," said a girl's voice from the back of the room, followed by a loud male whisper, "Hire the handicapped."

The others were starting without Rick. He could feel Screw and Hoss glaring accusingly at his back. And still his brain was empty. It was an enormous relief to hear the click of the PA system, right above his head, and a voice saying, "I am delighted to announce that we have been paid an unexpected visit by Congresswoman Pearl, who as I am sure you know serves on our Board of Education. All students and teachers will please assemble at once in the main hall."

Principal Rigden didn't sound delighted to Rick. She sounded ready to shit bricks. But the interruption would give him time to think. He stayed in his seat until everyone except Mr. Preebane had left the room, then he moved out and held the door for the teacher.

Preebane nodded his thanks. Rick closed the door; was careful not to lock it; and hurried after the rest of the class ahead of Preebane. He caught up with them as they were filing into the hall.

"What about some action, dipshit?" Screw Savage didn't wait until they were seated. "If I'd known you was goin' to just sit there like a dried-out dog turd, I'd never have held any draw. You can't hang old Willis out to dry, what the hell can you handle?"

"His dick." Hoss stood on the other side of Screw. "He's done it too much and softened his brain."

"Don't you believe it. I know what I'm doing. And it's something special." Rick glared at both of them. "But I need a little bit of help from you. You have to go sit down near the front."

"And where will you be?" Screw sounded suspicious.

"Right at the back. Near the door. The classroom's not locked, Screw. I was last out, I made sure it was that way."

"Ah!" The other two understood at once.

"What do you want us to do?" Hoss asked.

"Wait 'til the principal is ready to introduce Congresswoman Whats-it. It should get real quiet. Then you drop something."

"What?"

"Hell, I dunno. Anything. Anything that makes a decent noise."

Hoss dived into his pocket and came up with a handful of change. "This? People will scrabble around after 'em, too."

"Perfect."

"But the Rigger will have my ass in a sling for interrupting her."

"For dropping money and losing some? Don't think so. Anyway, if you're going to help, get going. I can't wait much longer. Have to find a seat near the side door."

Hoss and Screw nodded. Rick turned at once and started easing his way against the main flow of students. The seats at the back, usually filled first, were today half empty. Everybody wanted to see Principal Rigden wriggle and grovel, the way she always did with Board of Education visitors. Rick sat at the end of a row he had almost to himself, close enough to the open door for a quiet getaway.

He waited impatiently while the stage filled with the senior teachers. Willis Preebane was up there with them—that was surprising for a new and junior staff member. The honor didn't seem to make him comfortable; maybe because his ass would hardly squeeze in between the arms of his chair.

There was one student on the stage, too. Daniel Rackett. As valedictorian (*vale-dickhead*-torian, as Hoss usually put it) Danny would be called upon to say something to welcome their guest. He didn't look comfortable, either. He was peering at the headset that was supposed to read his speech into his ear. From the expression on his face it wasn't working right. Even from the back of the hall Rick could see his Adam's apple bobbing up and down.

Finally Principal Rigden appeared, smiling broadly and leading a large, red-haired woman in a green pantsuit. They moved to two empty chairs at

the front of the stage, Congresswoman Pearl sat down, and the principal turned to face the students. "I would like—"

There was the clatter of two dozen small coins falling onto the wooden floor. Some of them were still rolling when Rick quietly rose and slipped out of the side door.

The principal would speak, then Danny Rackett, then the visitor. Rick probably had at least half an hour. But that wasn't long for what he had in mind.

First he headed away from Room 33, keeping his eyes open for working videocameras. The contraceptive dispensers were down by the cafeteria entrance. They needed a student name and ID code before they would operate, but Rick was prepared for that. He entered "Daniel J. Rackett" and "XKY-586," waited as the valedictorian's ID was confirmed, and took the packet of three condoms. He did it twice more. Nine should be enough. If anyone checked today's records, Danny would get quite a reputation.

The corridors were deserted as he hurried back toward Room 33, opened the door, and slipped through. The tricky piece now was to disable the classroom videocamera without being seen by it. The cable ran along the ceiling, well out of reach. Rick scaled the open door and balanced precariously on top of it. He had no knife on him—anything that might form a weapon would never get past the school entrance—but his nail clippers were enough for this job. He crouched on top of the door, reached up, and delicately snipped

the thin grey cable.

He lost his balance as he did so and had to jump, but he landed easily. And finally he could close the classroom door. There was no way of locking it from the inside, but he felt a lot safer once it was shut.

He blew up eight of the condoms and tied their ends. They formed great balloons, a couple of feet long and nine or ten inches wide. He taped them all around Preebane's desk, stepped back, and surveyed his work.

It was a start, but it was not enough. He could imagine Screw Savage's sniff and critical comment: "Kindergarten stuff." He had to try for the rest.

Rick went to the door, opened it, and looked along the corridor. He had no idea how much time had passed, but everywhere was still silent and deserted. He left the door unlocked and hurried along to the washroom at the end of the corridor. He placed the end of the remaining condom over a faucet, held it in position, and turned on the water.

It took forever to fill. Rick put in as much water as he dared, until he was sure that the thin skin would burst under the weight. At last he tied off the end. The bloated condom had become amazingly heavy. He cradled it in his arms and headed back to the classroom.

The most difficult part still remained. Somehow he had to balance the monstrous condom right above the door, so that it would burst as the door swung open. And he had to get out, himself, after the trap was set.

It sounded impossible. Rick puzzled

over it, increasingly sure that he was running out of time, until at last he realized that he was trying to solve the wrong problem. He didn't have to leave the room at all. There was going to be total confusion after the door was opened. He could hide behind the desks at the back of the room, and leave when the excitement was over.

He spent ten nervous minutes arranging a harness of tape around the condom, then placed thumb tacks through the ends of the tape. Finally he dragged a chair over to the door and lifted the condom into position. He pushed the pins into the wall and made delicate adjustments. When the door was opened, its rough top had to just scrape the bottom of the condom enough to break it. But the condom felt so distended and tight, he was almost afraid to move it now.

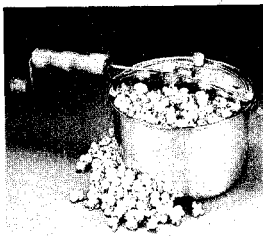
At last he realized that he was doing more harm than good. The changes he was making were loosening both the pins and the tape. He returned the chair to its original position and forced himself to retreat to the back of the room. He found a place which allowed him a narrow view of the door, with a very small chance of his being seen.

And then he waited. And waited.

What could be going on in the hall? There was no way to know how long Congresswoman Pearl would decide to speak. Certainly, Principal Ridden would not dare to interrupt a visitor who was a member of the Board of Education. Suppose that she went on right until lunch time, and the class did not return to this room?

Rick's legs were stiff and his knees

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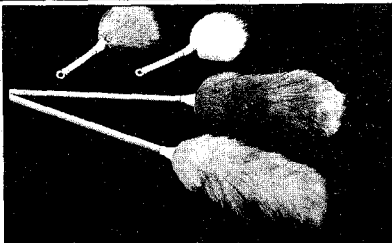


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sore from crouching on the hard floor when at last he heard the sound of footsteps clattering along the corridor. He tensed. He had not been able to lock the door, as he had originally intended. Maybe Preebane would notice that.

Apparently not. The metal handle on the inside was turning. The door opened its first inch and Rick heard Preebane's voice saying, "After you, Aunt Delia. I am weally glad that my clath will have you—"

The door swung open. Rick had one glimpse of Willis Preebane, ushering a large, green-clad figure ahead of him into the room. Then the giant condom, scraped by the top of the door, burst with a soft, subdued plop. Water deluged down.

Rick, peering through the narrow slit, had the sudden feeling that the flood had decapitated Congresswoman Pearl. He could see her red hair, sodden with water, lying on the floor.

Then he heard her scream. She clutched at her head. The hair beneath the wig was revealed as short-cropped and grey.

Behind the congresswoman and Preebane, crowding now into the doorway, came Rick's whole class. They were buzzing with excitement and delight. Delia Pearl's secret would be all over the school by lunch time. Rick saw Screw near the front, standing open-mouthed with astonished glee.

He felt a huge satisfaction. He had promised; and he had certainly delivered.

CHAPTER TWO

Rick also believed that he was safe

from discovery. In the melee that followed, the classroom had been total confusion. No one noticed when he joined the rest—even Hoss and Screw didn't realize that he had been in the room, and they had no idea how he had managed the trick until he explained.

It was a total shock to Rick when he was called out of class right after lunch and taken to Principal Rigden's office.

The principal was there. So was Congresswoman Pearl, the three assistant principals, Willis Preebane, and two other people whom Rick did not recognize.

The congresswoman had managed to dry her wig, and she was wearing it. That was a mistake. After its soaking it looked like a strip of cheap coconut matting wedged down onto her head. Beneath it, her blue eyes glared at Rick with undisguised hatred.

"This is the one?"

"We believe so." Principal Rigden wasted no time on formalities. She turned to Rick. "Ricardo Luban, do you know of the outrage that was perpetrated on Congresswoman Pearl this morning?"

"Yes." Rick felt uneasy, but he could not see how anything could be pinned on him.

"Will you admit that you were responsible for it?"

"I didn't do it."

"Were you in Mr. Preebane's class, before the assembly to greet the congresswoman?"

"Yes."

"And you were the last to leave that class?"

"Yes. I think so."

"Mr. Preebane?" The principal turned her head.

"He was the last. Definitely. He held the door for me."

"Did you?"

"Yes."

"And you locked the door after you, as you were supposed to?"

"Sure."

Rick felt easier in his mind. They were going to try to prove that he hadn't locked the door. He didn't think they could. And even if they did, that was a long way from proving that he had set the booby trap. But the principal didn't pursue that line. She merely nodded, and asked, "Mr. Preebane tells us that you then went on ahead of him, toward the hall. Is that right?"

"Yes." Rick was uneasy again.

"And you attended the general assembly?"

"Yes."

"And remained there throughout?"

"Yes." If they were going to ask him what happened in the hall, he was on solid ground. Hoss and Screw Savage had briefed him pretty thoroughly over lunch. Danny Rackett's headset hadn't worked right. He had tried to read his speech of welcome from printed sheets, stumbled over every word longer than one syllable, and made an ass of himself until Principal Rigden finally cut him off. She had then made a short speech herself, explaining what a wonderful person the visiting congresswoman was. And finally Congresswoman Pearl had offered her own contribution, telling the audience how pleased she was

that her own nephew, Willis Preebane, had decided to teach here, how talented he was, and how lucky the school was to have him. She hoped he would be really happy with his choice.

She had said it all twice, to make sure that the principal and the other teachers got the message, added that she was looking forward to seeing an actual class being taught, and at last sat down.

If Principal Rigden wanted anything more detailed than that, Rick would plead ignorance—and be sure that half the school remembered no more than he had been told.

"So where did you sit during the assembly?"

The question was totally unexpected. It left Rick floundering.

"I dunno."

"That's silly, of course you remember. Now, where?"

"I guess maybe I was near the back. Near the side door."

"Very good." The principal turned to the screen that covered one wall of her office. "Right here, in fact." She touched the wall. "This is you, is it not?"

The screen showed a videocamera still. The resolution was not good. Rick, sitting way at the back of the hall, was barely recognizable.

"Yes, that's me."

Mistake. Should have said maybe, not sure. He thought of changing his story, but it was too late. The picture had flashed off, to be replaced by another, and Principal Rigden was saying, "The first image I showed was taken at the beginning of the assembly.

This one was taken close to the end of it. The seat where you were sitting originally is now empty. Where are you sitting now, Ricardo Luban?"

"I moved." Rick spoke automatically, but he knew he was doomed. If they had been able to locate him on the video image. . . .

"We are quite sure that you moved." The principal stepped away from the wall screen. "But where did you move to? During the lunch period we managed to identify every student in school today, in both the first and the second picture. I should say, every student except one. You are present in the first image, and absent in the second. Now would you like to confess?"

Rick shook his head. They had him on ice, but he wasn't going to admit it. He would plead innocent today, and tomorrow, and if necessary for the whole of the next two years, until the end of his time in school.

It was with disbelief that he heard Principal Rigden saying, "I quite agree with you, Congresswoman Pearl, and with the other board members. Guilt is established beyond reasonable doubt. Such people have absolutely no place in this school or in our school system. We will take action for expulsion as soon as the necessary signatures can be obtained and the paperwork completed."

"For the final, official decision." Delia Pearl stared stonily at Rick. "But unofficially, pending that decision, expulsion will happen today."

"Today?" Principal Rigden hesitated. "Very well. Of course." She turned to Rick. "You are expelled from this school, effective immediately. The fi-

nal notification will follow in a day or two. Please collect your possessions and leave the premises as soon as possible."

"You can't do that!" Expulsion, for a simple practical joke that had really hurt no one? Rick knew a student who had broken his language teacher's arm, and another who had deliberately run over a science teacher in his car. Explosive booby traps for other teachers had been set, filled with shit or warm tar. But those people had received only trifling punishments.

"I think you must let us decide what we can and cannot do."

"I'll sue. I will."

For a second everyone stared at him. Then they all smiled.

"Sue a Congresswoman?" The principal laughed aloud. "And what lawyer do you suppose will take your case? Get out, Luban. You are as ignorant as you are stupid. Go."

Delia Pearl's mouth twisted with satisfaction, and she turned to Preebane. "Willis, I do not feel that we can trust this young man one little bit. Would you please accompany him when he collects his possessions, and then escort him off the premises."

"Of course." Preebane did not even look to the principal for confirmation.

Rick was led away. He was too dazed to resist. He hardly saw Hoss or Screw or the other members of his class as he picked up his school bag, and he did not say a word when he was escorted to the front door and his ID was canceled from the entry system. He walked out into the afternoon sunlight and stared around him as though he were on an alien planet.

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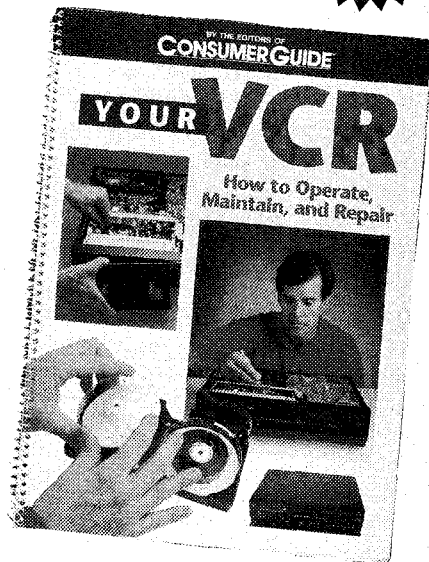


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He went to the side of the school, walked out beyond the sports field, and sat on the grass. He was still sitting there when school was released for the day. Occasional students passed by. No one spoke to him. He did not stir or speak to them. Only when a long afternoon shadow fell across him, and silently remained there, did he look up.

It was Mr. Hamel, more like a turtle than ever as he stood motionless with his head pushed slightly forward. He nodded at Rick.

"Caught at last, Luban. And not before time."

"You heard what happened?"

"The whole school heard. Would you like to talk to me about it?" And, when Rick shook his head, "Very well. That is your option." He began to walk away across the grass.

"Wait!" Rick struggled to his feet and hurried after him. "I don't want to talk, but I want to *ask*."

"Better yet. We learn by asking, not by talking." Hamel continued on his way, slowly pacing out of the school grounds and into the street. "So ask."

"Why *me*? I mean, why did the motherfuckers dump on me like that? What I did wasn't any big deal compared to some of the shit that goes down all the time in school."

They had come to a bench. Hamel sat down on it and gestured to Rick to join him.

"Must you employ such language? Is your vocabulary so meager that you are incapable of other forms of expression?"

"What'll you do, expel me? You never hear people talk like that?"

"I hear people talk like that every day." Hamel sighed. "It never ceases to grate. Do you want people to wish that you were not around them? It's easy enough to do. Or do you want answers?"

"Answers. Why did they dump on me?"

"Very well. Answers you shall have." Hamel paused, studying Rick from battered sneakers to razor-cut hair. "You are not stupid, Luban. But you are a fool. For one thing, you consort with people like Savage and Carlin, who really are stupid. You are also ignorant, cynical, amoral, and unthinking. Wait a moment." He held up his hand. Rick was starting to stand up. "I am going to answer your question—or rather, I am going to let you answer it. You are—how old? Sixteen? So you have been in the education system for eleven years. And what have you learned?"

"My grades are all right."

"Certainly. Because nothing is required of you. It is easy to hit a target pasted to the end of the rifle. We are also required to make you feel good about yourself. The technical term is to 'raise your self-esteem.' While you were in school I could not have spoken to you this way, because you had to be protected from the truth. Now I can. Despite all the work that we have done to raise your self-esteem, surely you must know that you've learned very little."

"I do all right," Rick protested again—half-heartedly.

"You 'do all right.' Indeed. What does that mean? Let us examine what you know."

"You can read short, simple words, but only those you have seen before. You have a reasonable speaking vocabulary—when you choose to exercise it—but you are unable to read more than half of the words that you know. You have a rudimentary knowledge of simple science, and you can do simple arithmetic. I've hammered some biology into your skull, but you know little mathematics, and no economics, geography, history, arts, or languages. You can recite all manner of juvenile song lyrics, but you are ignorant of real poetry and literature. And you would be little better if you stayed here another two years and graduated."

"Reading from books is a waste of time. Like adding up numbers. I got a calculator to do that. Reading's ancient history. The readers do it for us fine."

"They do—when they work, and when you have one available. But you miss a point. A person who cannot *read* can also not *write*. Writing—and revision—is essential for completeness and clarity of expression. But I do not want to digress. You have been in the education system for eleven years. How much, in that time, have you learned about the system itself, and how it works?"

Rick considered the question. He had never had the slightest interest in the education system. Nor did anyone else in his right mind.

"Not much."

"But you have enough information to work things out for yourself. For instance, whom do I work for—to whom do I report?"

"Principal Rigden."

"And to whom does she report?"

"I dunno. I guess, the Board of Education."

"Good enough. There are a couple more layers in there, but that will do. Now here's another question. How much of the county and state's total budget goes on education? I don't expect you to know the answer to that, so I will tell you. It is about four-tenths. That's an awful lot of money, a huge vested interest at work. Now, who decides what that amount will be and how it should be allocated?"

"Congress?"

"For all practical purposes. Very good. So let us climb the ladder of status in society. If you play one of your unfunny 'jokes' on a teacher, and are caught, you pay a small price. But a teacher, most students are amazed to learn, is the *lowest* form of life in the school system. Do something to the principal, that's worse, and the punishment is more severe. To a Board of Education member, worse yet. And to a *congresswoman*, who is also a member of the Board of Education—"

"I didn't know I was doing something to a congresswoman."

"That is the plea of the foolish through all of history: *I didn't know what I was doing*. But I, speaking as a teacher, tell you that I have no sympathy for you. Is it better to insult and offend and diminish me or Willis Preebane, rather than Congresswoman Pearl, simply because the punishment is less? That is the logic of a coward."

"I ain't no coward!"

The Sun was setting in their faces, and Hamel shielded his eyes with his

hand. Rick could see the deep lines on his cheeks and around his mouth. Hamel seemed ancient, far older than when he was teaching his class, until suddenly he lowered his hand and turned to face Rick. His eyes were alert and astute, changing his whole face.

"I believe that you are not guilty of *conscious* cowardice. So now for some good news. Until today you were destined for two more years of schooling here. Did you have any thought of continuing beyond that?"

Rick shook his head. For the past three years he had wanted to finish school and get out of it more than anything. "Mick makes me stay in school because Mom gets the education incentive bonus in the welfare. I'd be long gone if I could."

"So now what happens to you?"

"I don't know. Sit around and watch the tube, I guess, until they throw me out. Mick's goin' to kill me. The education incentive was 940 a month and we only get 6,200 altogether."

"So your education is a good part of the money. Of course you don't get it yourself."

"Naw. Mick takes it. He's gonna hate losing that 940. Fifteen percent—"

"It is that. You do percentages in your head?"

"Sure. That's useful, you need it to play the numbers."

"An undoubtedly valuable skill. Now that you are out you will have more chance to exercise it. But suppose that you had stayed in school. At eighteen, you would graduate. Even with your minimal skills, you would receive your diploma. Then you

emerge and offer your talents to a waiting world. Did you have any plans as to what you would do?"

"Find a job, I guess. There's supposed to be plenty of jobs around."

"In laundries, or fast food places. Or running a scanner, there are usually jobs in data entry. There's also the Job Corps, make-work jobs cleaning litter from parks. Plenty of those. That sound good?"

"Naw, but there's other stuff."

"Not for you. The fact is that perhaps two dozen of your two hundred classmates—12 percent, as you will readily confirm—have skills that anyone wishes to pay for. Of course, nearly everyone has the grades to go on to junior college."

Rick shuddered.

"You wouldn't learn any more there than you have in school," Hamel continued. "But it would keep you off the streets, and separate you from the genuinely stupid. Better than nothing, but still leading to a dead end."

"Bigger education incentive, too—it goes up to a thousand a month."

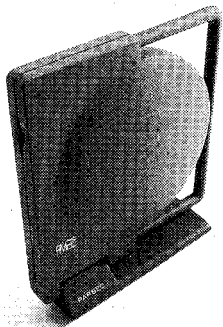
"A thousand a month, to stay in junior college for two years. At the end of that time would you possess any salable skills?"

"I don't know," Rick protested. He shook his head. "The way you talk, I guess not. So who gets the real jobs?"

"Who do you think? Those who have the real skills. A few of your classmates, perhaps, but mostly students from company schools. People who know something, people who have learned how to work hard." Hamel shook his head sadly. "It pains me that I have lived to see the transformation

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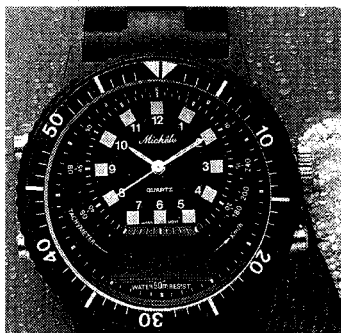
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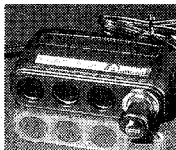
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of the United States from a republic to a feudal aristocracy. Not pretty."

"I don't know what you're talking about."

"No, I don't suppose you do. That's part of the problem. You ask who gets the jobs. The answer is, people with knowledge and drive. There are jobs for them. Not for an arrogant, semi-literate, unfocused, trouble-making know-nothing. Not for amoral, idle, cynical wasters, which is what you'd be if you stayed here. I told you I had good news. Here it is: you are *fortunate* to be expelled from this school. Had you remained you would have wasted another two years, and at the end of it you'd have no more knowledge or capability than you have today."

Rick stood up. "I don't need to take this crap from anybody. I'm going."

"Very well. Going where?"

Rick shook his head. "I dunno. Mick's going to kill me." He knew how it would happen. When they found out that the education incentive would stop, his mother would scream and her boyfriend—Rick's "stepfather," though he certainly wasn't—would tell her to shut her yap. Then they would start in on each other. Finally when the fight between them cooled off they would gang up and turn it all on him.

"Going home, I guess. I got a truce with the gangs but I can't be out after dark unless I pay, and I don't have money."

"And tomorrow morning, when you get up and school is closed to you?"

"I don't know. Look for a street job."

"Selling dope?"

"I don't know; what else is there?"

"Theft. Shoplifting. Working as a pimp. Admittedly those don't pay as well as being a pusher, but they stay out of jail somewhat longer. Live longer, too."

Rick knew what that meant. Most rackets were controlled by gangs, or even by adult mobsters. Mick, his current stepfather, claimed to have good connections, but nobody believed him. Especially not Rick, because he had asked about getting set up in a good racket, and Mick kept stalling him. Rick was sure that Mick didn't know shit about real rackets. And if you didn't have connections you wouldn't last long. You'd get busted or shot, maybe both.

Rick shook his head. "I guess I don't know what I'll do."

"I assumed as much. However, I have a suggestion." Mr. Hamel handed Rick a small yellow card. "Can you read what is written there?"

Rick stared at the card in the fading light. "Eight-one-five-two." He paused. The numbers were easy but the words were long and unfamiliar. At last he shook his head. "Not without a reader."

"Then I will tell you. It says, 8152 Chatterjee Boulevard, Suite 500. Can you remember that, and find the place?"

"Sure." Rick stared at the card. "Say it again."

"Very well—8152 Chatterjee Boulevard, Suite 500."

"Got it." Now that he'd heard the words he could sort of read the card, at least enough to remind him.

"If you go there tomorrow there is a

possibility of useful employment."

"A job?"

"Exactly. Not an easy job, but a worthwhile one. The most rewarding jobs are always the most difficult ones. You may keep the card."

Rick studied the words, silently mouthing them to himself. "I know how to get to Chatterjee Boulevard. If I went there tonight, would someone be in Suite 500?"

"I cannot say." Hamel stood up. "I must go now. But you have the right idea. Action is usually preferable to inaction."

Rick stood up, too. He wanted somehow to thank Mr. Hamel, but he did not know how. "Why are you doing this for me?"

Hamel paused. "Certainly it is not because I like you, Luban. I do not. As I said, you are a fool. And you are—"

"Ignorant, cynical, amoral, and unthinking. I heard you."

"Correct. Did I omit to say *lazy*? But you are not stupid. You are, I think, basically very intelligent. However, all forms of tests that might suggest one student is more able or talented than another were long since judged discriminatory, and banished from our school system. Therefore, I have no objective basis for my conjecture. But I do hate waste. You and your friends have been wasting your lives."

"I still don't understand. You just told me I'm good for nothing."

"You are—today. I did not tell you that you lack potential. It is all relative, Luban. You believe that the antics of your friends are daring and wicked. You will be amazed to learn that this school, despite its many failings, does

not come close to the bottom of the heap. Go south with me ten miles, and I will show you schools like armed camps, schools where student and staff murders and rape are a daily event. For you, with all your flaws, there may still be hope. I would like to think so."

Hamel nodded and started to walk away, a small, stooped figure in the twilight. "Do you think I'll get a job?" Rick called after him.

"I cannot say." Hamel did not pause or turn around. "But if you do, wait a while before you thank me for it."

CHAPTER THREE

Mr. Hamel had sensed the truth: Rick could not face going home. The school might not have called his mother, but somebody would have contacted her to make sure she knew there wouldn't be any more education incentive money coming in. Nine hundred and forty a month. It would stop today. He never saw one cent of it, but they would make him pay. Mick would wait up for him, drunk or drugged but anyway in a foul temper.

If only, when Rick finally had to go to the apartment, he could tell them that he already had some sort of job, some way to bring home some money. . . .

It seemed like the thinnest of straws to grasp at as he descended from the overhead Public Vehicle at the corner of Chatterjee Boulevard and began to walk along toward Number 8152. He had to push his way through crowds of young men and women, standing or wandering aimlessly along the littered street. They were part of the

Pool. Not more than one in ten of the Pool would have a job of any kind—ever. Yet many of them had graduated high school and junior college, and some of them from a real college. Rick had already known most of the things that Mr. Hamel had told him. He had just never thought about them.

They didn't want us to think about them. Rick remembered what Mr. Hamel had said about self-esteem. He'd heard some of that before, too, but it hadn't seemed worth bothering with. *They want us to feel good and not think about the future. And it works, too. Why should we?*

Number 8152 was a ten-story windowless building, its featureless walls made of grey lightweight carbon composite. Rick waited stoically as his ID was verified by the automatic guard and the card given to him by Mr. Hamel was read. It was close to eight o'clock at night. On the way here he had convinced himself that Suite 500 would be empty.

That conviction grew when he at last stood outside the entrance of the suite. He could see through the shatterproof glass door that it was just one room. It had plenty of computers and displays and printers inside, but no people.

He touched the attention panel anyway, and was astonished when after about ten seconds a woman's voice responded, "You are at an office of Vanguard Mining and Refining. Please identify yourself."

Rick went through the ID process all over again. He showed the little card and stumbled through the explanation that it had been given to him

by Mr. Hamel, and why. The woman did not say another word, but at last the door swung open. Rick went in. The door closed behind him and one of the television monitors came alive.

"Sit down right here."

Rick took the only seat near the monitor. Now he could see the woman on the screen. She was small, thin, and sharp-featured, and somehow reminded him of an animal. A rat? No. Not quite.

She was examining something in front of her, not visible to Rick. "You are sixteen years old. You have been expelled from school. And it is eight o'clock, your time. Right?"

Each of the statements was true enough, but taken together they made little sense.

"That's right."

"I want you to tell me exactly why you were expelled from school. Take your time and give as much detail as you can. I'll try not to interrupt. If I do there will be a delay of about five seconds between what you say, and my comment or question. So you may have to back up occasionally and say things over. Go ahead."

There was a temptation to lie, or put things in a way more favorable to Rick. Some instinct warned him that would be a mistake. He recounted the whole episode, from the arrival of Willis Preebane to Rick's interrogation and expulsion by Principal Rigden. It was difficult to talk about the condoms and the booby trap. After the fact it sounded so stupid and pointless and unfunny. Rick was sure that any hope of employment with Vanguard Mining was evaporating with every

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word he said. He plowed on, ending with his decision to come to this office tonight even though it was so late.

"Not late where I am," the woman replied. "I got up just two hours ago. But are you tired?"

Just got up. She had to be somewhere on the other side of the Earth! The speech delay must be caused by the satellite link. "I'm not tired."

"Good. Can you read?"

"A little bit." But five seconds was far too long for a satellite link delay. Rick struggled to remember things that had never before been of the slightest interest to him. Radio signals traveled at the speed of light. But how fast did light travel?

"Can you write?"

"Just a few things."

"Hell." The woman's opinion of his reply showed more in her tone of voice than in her comment. "Well, no matter. We'll manage. I want to give you a whole set of things called *aptitude tests*. First, though, we have to deal with a few formalities. You never had tests like this in school, because they're forbidden in public programs. We're a private company but still the tests can't be given to you without suitable consent. In the case of someone like you, less than eighteen years old, that consent has to come from a parent or guardian."

Rick felt an awful sinking feeling. He was going to be sent home after all with nothing to tell except his expulsion from school.

"Problem with that?" The woman must have been studying his face. "Tell you what. Suppose that we give

you the tests anyway, see how you do. If the results are good you can get consent later and we'll postdate the tests. If they're not good, we purge the test results from our files and you're no worse off."

What she was suggesting sounded illegal—but if that didn't worry Vanguard Mining, it sure didn't worry Rick. He took a deep breath.

"I'm ready."

"Any last question before we begin?"

Rick shook his head, then changed his mind. "You said you just got up. Is it morning where you are?"

"Morning, afternoon, evening, anything you choose to call it." The woman smiled, to show small, sharp teeth. Rick suddenly caught the right animal resemblance. Not a rat, but a weasel—though he had never actually *seen* a live weasel. Mr. Hamel had somehow taught Rick more biology than either of them realized.

"I'm on CM-2, one of Vanguard Mining's trans lunar training stations," the woman went on, "about seven hundred thousand kilometers away from Earth. But the tests will be delivered where you are by a local program. I'll still be here if you get stuck. Don't call me unless you absolutely have to, though—the tests are timed. Ready to go?"

Rick nodded. His heart was racing and his mouth felt too dry to speak.

The woman's picture vanished from the screen and was replaced by a sequence of numbers.

"Good luck," said her disembodied voice. "Do well on your tests—and one day maybe you'll come out here

and see this place for yourself."

Rick had painted a mental picture too good to be true: he would pass the tests, Vanguard Mining would offer him a job, and he would be whisked away at once to space and his new employment.

It was a dreadful shock to learn that the first set of aptitude tests was no more than a beginning.

"Not bad," said the weaselly woman, whose name was Coral Wogan. She was studying a copy of Rick's efforts, and he was terribly aware that he had not managed to complete even one of the tests. "Not bad at all," she went on. "You did well enough that we'll put you on the company payroll while you take the next set."

"Next set?" It was after midnight and his brain felt like mush.

"More extensive tests. Mostly physical this time. They last about two weeks. Now, take these"—a linked batch of forms came stuttering out of a printer close to Rick—"and fill them out. All right?"

Rick took the forms and glanced at the first one. He could see at once that it was full of words too hard for him to read, but he was not going to admit that to Coral Wogan. He'd get the help he needed, if he had to go back to school and beg for it. He nodded.

"Three of them call for parental signature," Coral Wogan went on. "What's your father's name?"

"My real father? Milo Luban. But he hasn't been around since I was three years old."

"Your mother, then."

"Dora Luban."

"Right. Give her this, and tell her that there will be more coming when we receive the signed parental permissions. I rely on you to persuade your mother to sign."

Another narrow form rolled out of the printer. This one Rick could read. It was a check, made out to his mother from Vanguard Mining. For two thousand! More than double the monthly ninety-fourty of the education incentive.

"She'll sign."

"Good. One thing more, then you can go home and get some sleep. How soon will you be ready to start?"

Now—then I don't have to go home at all. But that would not work. He needed to fill out the stack of forms, and he needed his mother to sign.

"Will tomorrow evening be all right?" He knew what would happen if Mick saw that check. One of two things. Either there would be a tremendous fight, or Dora Luban would agree to cash it and the pair would go off on a prolonged roller-coaster ride of drink and drugs. Either way, Rick didn't want to be home for the nighttime brawl.

"Tomorrow evening should be fine," Coral Wogan said. "Here's the only other thing you'll need."

One more piece of stiff paper scrolled from the printer. Rick grabbed it and studied it. This one looked like a ticket—an air ticket, to somewhere with a long name. He tried to spell the word out—A-L-B-U-Q—but it was too hard.

"Albuquerque." Coral Wogan showed her first sign of impatience.

"You fly there, then by shuttle bus to our facility at Tularema. You are allowed to bring up to twenty kilos of personal possessions. Don't bother with additional clothes, they'll be provided. Have you ever been to New Mexico?"

"Never."

"You'll like it. Some of the tests, though, you won't like them. I guarantee that."

She grinned—small mouth, sharp little teeth. "Any more questions?"

Rick was tempted to ask what she meant about the tests, then decided not to. "No."

"That's it then. Again, good luck."

The screen darkened, leaving Rick clutching forms, check, and ticket. He wondered how he was going to find his way home safely in the dangerous early hours of the morning.

Rick had never flown before, and he was not sure that he liked it—a bad sign for someone hoping to go out to space. Every other passenger seemed totally relaxed, while he in his window seat noticed each vibration and every whir and thump and whistle of mechanical equipment.

As the plane climbed at a steep angle and pressed him back in his seat, he stared outside at the dwarfed buildings and roads and tried to move his mind to other things. All he could think of was the bitter memory of his last hours at home.

Mick, thank heaven, had been out when Rick first got there. His mother had signed instantly, hid the check in her purse, and told him to get on with filling out the rest of the material. He

had walked over to sit outside the school, struggled through the forms unaided, and delivered everything by mid-afternoon to the Vanguard Mining office.

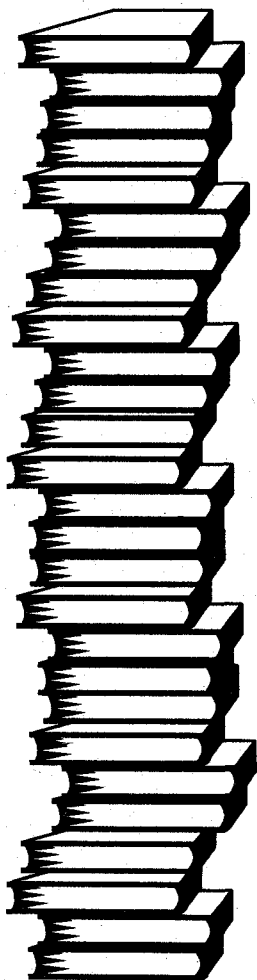
He saw no one and spoke only with what seemed to be a computer. But everything must have been in order, because after five minutes another check came spitting out of the printer.

Rick received travel instructions and returned home to pack. Twenty kilos was more than enough—five would have done him. While he stuffed the few things he valued into a couple of plastic bags, his mother hovered over him. After signing the permission forms without hesitation she was now moaning and weeping and pretending to be heartbroken. But she could not keep her eyes off the second check that Rick had brought from Vanguard Mining. Mick had grabbed this one, the three thousand dollar "sweetener" that expressed the company's financial appreciation of Dora Luban's willingness to sign over complete parental control of her child. As for the first check, if his mother did not mention that to Mick, Rick was not about to do so.

His stepfather had been even worse than his mother. Mick hadn't pretended. He didn't try to hide his relief at getting rid of Rick, the "troublemaker" too bad even for the school system. When Rick came home and told them about the Vanguard Mining tests and the job prospect mining the Belt, Mick had asked only one question: "When do you go?"

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hazards of an off-Earth assignment. No query as to how long it would be before Rick returned. Just, "When do you go?"

When do you go? Rick stared out of the plane window. Think of it this way: it sure made leaving home pretty easy.

They had reached cruising altitude and were in level flight. Rick was gazing down on stark, snow-capped mountains, their valleys already in shadow as night approached. There was no sign of buildings or roads, no evidence from up here that humans even existed. If anything went wrong with the plane, there was no place to land down there among those dark rocks.

Rick looked at the other passengers. Some were his age or younger, but they were all dressed in a very different style. It was clear that not one of them shared his worried thoughts. They were chatting, reading, playing, working, or sleeping, without a trace of interest in what lay outside the aircraft windows.

It was time to accept that life was different now. He was entering a whole new world. The old world had been washed away in the flood of water that poured down on Delia Pearl's head and took off her red wig. Rick, in this new world, had to learn to think differently.

He closed his eyes. He had not slept for more than a short nap in the late afternoon, and he was dreadfully tired. He smiled to himself. Say what you like, the school had a new legend now. Whenever anyone tried a trick on students or teachers, somebody

would say, "Ah, but that's nothing. You should have seen the stunt Rick Luban pulled. Old Rick was the absolute wild end."

What would it take to become a legend in the world that he was entering now? . . .

The landing at Albuquerque brought Rick out of a deep and uneasy sleep. When they touched down he at first had no idea where he was. Most of the other passengers were already on their feet while he was still struggling with his seat belt. He stared out of the window at a runway dusted with white, rubbed his eyes, and groped around under the seat for his two plastic bags. One of the last people off the plane, he followed his directions through a near-deserted airport, and then outside again to look for the minibus that was supposed to be waiting for him.

Heavier snow was starting to fall. The air felt thin and cold. He understood now why Coral Wogan had told him not to bother with his own clothes—he didn't have any warm enough. But what was he supposed to do until he arrived at Tularema? Freeze to death?

The bus was one of the new autopilot runabouts, still illegal for city use. Rick had seen them on the tube, but he had no idea how they worked. Some sort of overall navigation gadget, he guessed, taking its position from a satellite receiver in the bus's roof. A radar told the onboard computer where other cars and trucks were, and how fast they were going.

Rick approached the bus and hesitated. He had seen a dozen accident

videos in the past year, people killed in auto-pilot buses and cars that ran off the road into rivers or smashed into bridge supports and other cars. An auto-pilot bus was not his choice for a middle-of-the-night ride with snow and slippery roads.

While he stood there, the bus's rear door opened and a gruff voice came from the dark interior.

"You gonna stand all night playing statues? We been waiting two hours. Get inside and let's hustle outta here."

Rick swallowed his surprise—he had expected to be the only passenger. He bent his head and climbed into the bus. It was hardly warmer inside than out. Two other people were sitting on the broad seat, so muffled up in dark blankets that at first glance he could make out little more than their heads.

"Tularema?" asked the same voice. As Rick's eyes began to adjust he saw next to him a big, broad-shouldered youth not much older than him.

"Yes."

"Vanguard Mining?"

"Yes."

"Then why don't this dumb bus get out of here?"

"Because the door is still open," the other passenger said calmly. It was a girl, sitting on the far left. She touched something on the panel in front of them. The rear door clunked shut, and at the same moment a blue interior light came on and the bus began to move smoothly forward.

Rick studied the other two, aware that they were staring at him with equal curiosity. The male was easy. He could have fitted right in at Rick's

school. He was big—even bigger than he seemed at first glance, because it turned out that most of that bulk was muscle and not clothing. He had long, swept-back frizzy hair, a broad, very black face, and dark, close-set eyes. The left one was bloodshot, and he kept rubbing it. He had the same cocky, look-at-me expression as Hoss Carlin.

"I'm Vido Valdez," he said. He did not offer to shake hands.

"Rick Luban."

"You're gonna freeze your ass off in that outfit." Valdez did not offer to share the blanket sitting on his lap.

"Let's hope it's going to be a short ride," Rick said, and reached out to pull part of the blanket across his chilled legs and feet. He ignored Valdez's scowl—he could see trouble ahead there—and turned his attention to the girl who was smiling at him in a superior sort of way.

"It won't be," she said.

She was something else. For a start, she was tall and thin and pale and weak-looking, like a plant left too long in the dark. Mr. Hamel had taught the class a special word for that—eeti-o-something. Even her hair, pulled back from her narrow face, seemed weak and thin. If she was heading for the physical tests that Coral Wogan had promised Rick at Tularema, it was hard to believe she would pass any one of them.

The real shock, though, was those eyes. Rick stared at them, and had the feeling that there was nothing behind them. They were grey and wide and utterly without expression. The smile that she offered Rick somehow did

not extend from her mouth to the rest of her face.

"If you're hoping for a short ride, forget it," she went on. Her voice was small and precise, a little girl's voice. Rick had the strange feeling that despite her size she hadn't matured sexually. "Albuquerque to Tularema," she continued, "is nearly three hundred kilometers. Even without stops, and I don't know if the bus has any scheduled, we won't get to Tularema until the middle of the night. It shouldn't be too bad, though. The heat comes on a lot better when we're moving." Almost as an afterthought, she added, "And I'm Alice Klein. From the Black Hills—western South Dakota."

Rick decided that, physical weakling or not, in her own way Alice Klein was as self-confident as Vido Valdez.

"I'm from Anchorage," Valdez said. "If you think this is cold. . . ." He stared at Rick, and he was grinning. "I think she's right, though. This shouldn't be too bad—once we get to Tularema."

He looked with satisfaction at Rick's puzzled expression. "Didn't they tell you? Or didn't you sign up with Vanguard Mining?"

"I did sign up. Tell me what?"

"That you're out here for physical tests."

"They told me that."

"Ah, but did they tell you the rest of it?" Valdez turned, so that his smirk could take in both Rick and Alice Klein. "I guess they didn't. Don't you realize that these will be *competitive* tests? Not everyone who signs up gets a job and goes to space. We're going to be fighting against each other. And

I'll tell you now: I intend to win."

Tests. Rick had been taking them in school for as long as he could remember. There was a definite technique to them.

Rule number one: find out if it mattered. Some teachers gave you tests, but there was no penalty if you scored zero or filled the screen with doodles. Then you and your buddies horsed around through the whole thing or cut it completely.

If the teacher played tough like old Hamel, you changed tactics to rule number two: sit near one of the goody-goodies like Belinda Jacob, someone who was likely to know the answers. Watch what she did, copy all you could, and deny to the death that you had cheated.

He knew within minutes of arriving at Tularema that this was going to be different. For starters, they arrived tired out and chilled in a bleak February overcast. Rick expected food and rest. Instead they were ushered at once into a grim medical facility. A man in a grey suit greeted them. Doctor Alonzo Bretherton read his ID card, but he didn't look like any doctor Rick had ever seen—he was more like a barroom bruiser, all muscles, jug ears, flattened nose and broken veins. He took one look at them and said, "Klein, Luban, and Valdez. Right. A quick physical, then it's track suits and a treadmill."

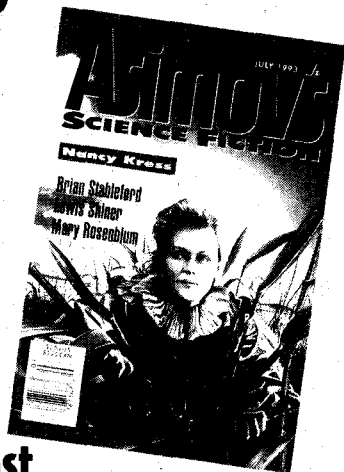
"We're frozen," protested Valdez.

"And starving," Rick added.

It was no lie. Even with the blankets, the night journey at two thousand meters above sea level (Alice

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Klein seemed to know everything) had numbed them. There had been no stops, for food or anything else.

"Exactly as you should be," Brether-ton said cheerfully. "I need to catch you at a physical low point, and it's easier to do it now than starve you or keep you up all night later. Let's go. Those three cubicles."

Rick was ready to say it—*Screw you, Doc, I'm not doing no stupid treadmill*—when he saw Vido Valdez's mouth opening. They stared at each other. Finally Vido scowled and walked forward toward one of the three rooms that Brether-ton had pointed out. Alice Klein had already vanished into the left-hand one.

Find someone who was likely to know the answers. That was a laugh. Rick changed into the skimpy grey gown that he found in the cubicle and stared at himself in the mirror. Wonderful. Enough to cover him to the thighs, but no matter how he adjusted it part of his ass was showing. Alice Klein was due for a treat.

Except that there was no sign of her when he emerged. Rick was shuttled along to another room, where a man and woman he had never seen before performed an hour-long physical on him. It was more unpleasant and painful than one of Mick's grade-A beatings.

"Which would you rather," the woman said when he complained. According to her badge she was a company paramedic, Tess Shawm. She was young and very attractive, but it was obvious that so far as she was concerned Rick was nothing more than a piece of meat. "Would you pre-

fer to find out you have a problem now," she went on, "with full medical facilities on site—or find out when you're halfway to the Belt and it's fifty million kilometers to the nearest doctor?"

It was no consolation, when Rick was at last released, to see Vido Valdez and hear him grumble, "The hell with this. They were pokin' into holes I never knew I had."

Vido stared at Rick's gown and then at the close razor haircut that Rick had been so proud of two days ago, and added, "I knew you were weird, Luban, the second I saw you. You got more hair on your ass than you have on your head."

Fighting words. But before Rick could do more than raise a fist Brether-ton was standing between them.

"Fun and games later, you two. Go in there and get track suits on. Time for the treadmill and the EKG."

Rick would like to have used that raised fist on Brether-ton, but the doctor's bare arms were as hairy and muscular as a gorilla's. Vido Valdez was already moving away. After a moment Rick followed.

The treadmill was nothing but a sort of walking machine with an angle that could be adjusted to make you think you were going uphill. Rick waited while a bunch of electrodes were attached all over him, then the belt he was standing on began to move. He started walking. It was dead easy. He was no jock, but running the streets kept you in fair shape. He began to feel warm for the first time since he left the plane. Vido Valdez was two machines over, grunting and

puffing but striding out steadily. Rick knew this test couldn't be a big deal, because beyond Valdez he could see Alice Klein, strolling easily along on her long, skinny legs.

Then he started to feel something else. It was becoming hard to breathe, and his heart was pounding away in his chest faster than he ever remembered. He put his hand to his throat.

"What's wrong?" The same man and woman attendants were with them, watching the walkers and the monitors. Tess Shawm came to stand by Rick's side.

"Can't breathe." Rick hardly had wind to speak. "And I hurt—here."

She nodded. "Where you from?"

"Simi Valley—California."

"Near sea level, right?"

"Uh-huh."

"And now you are more than a mile high. Thinner air. What do you expect?" Shawm checked the monitors. "You're all right. Heart's fine. Just keep walking."

Rick walked. The pain in his chest grew, and soon it was matched by an awful tired ache in his legs. Instead of slowing the treadmill, Tess Shawm was speeding it up and increasing the slope. Finally, when Rick knew he could not go for one more second, the machine slowed and stopped. He stood still, his hands gripping the metal bars on either side of him and his head down to his chest.

"You need to take regular exercise," Shawm said. "I'm going to make a note of that. But you'll do. You can get down now."

Rick stumbled off the treadmill. He saw Valdez next to his machine, dou-

bled over, hands to his right side. Unbelievably, Alice Klein was still on her treadmill and still striding along easily.

"Don't get all shook up." Tess Shawm saw Rick's startled expression. "She has an advantage over you two. She went to school in the high part of the Black Hills. For the past two years she's been living up close to a couple of thousand meters. Like prolonged altitude training. She can walk both of you into the ground."

She already had. Vido Valdez and Rick went side by side to the showers in grim silence. Valdez didn't tell Rick this time that he intended to win.

CHAPTER FOUR

There was a temptation to say, *I've had it. You can take the tests and stuff 'em. I quit.*

But if you did that, what came next? Rick, puzzling over the words on his air ticket, saw that it had a return half. He could use it to fly back home any time.

And face his mother, and Mick, and admit failure yet again. And after that?

Things didn't seem so bad after Rick had eaten a huge meal, slept around the clock, and woken to eat again. His legs still ached and more tests lay ahead, but he decided that, like Vido, he intended to win.

His decision was made easier when he realized what he should have known all along: he and Vido Valdez and Alice Klein were not the only three being tested. They were merely the most recent arrivals. There were fifty-two other recruits at the facility, all between the ages of fifteen and eighteen. All of them were present in

the dining room when Rick appeared for his second meal, and they stared at him and at the other two new arrivals in an unfriendly way.

He found out why later that day, talking to Alice Klein who still apparently knew everything. A maximum of twenty recruits would go on to the next stage of off-Earth training. Every new arrival decreased the chances of the people already there. Vido Valdez had been quite right, the situation was competitive. Less than 40 percent of the applicants would be winners.

The quality of the competition became apparent as the tests continued: manual dexterity, physical strength, speed of reflexes, hand-eye coordination, color and stereoscopic vision, ability to perform several activities in parallel. In each category there seemed to be an outstanding performer, someone who was rumored to score far ahead of everyone else. Rick was discouraged to find that he was best in nothing.

And something else became obvious. Rick and Vido Valdez might be in competition with all the other trainees, but Valdez saw the contest in more personal terms. To him, Rick was the enemy.

"I'm gonna beat you, Luban." They were eating, and Valdez was sitting opposite Rick at one of the plastic-topped tables. He was still rubbing his left eye now and again. Rick suspected that it was a nervous habit, the eye red only because of constant irritation. If it was anything real, the Vanguard Mining doctors would have done something about it. They might be ruthless and heartless, but they

were certainly competent.

"I'm gonna whip your skinny ass," Valdez went on. "Remember this: anything you can do, I can do better."

"Sure. Like you beat me real good on the balance bar." Rick hadn't been present when Valdez took that test, but he had heard about it from another trainee, a loudmouth boy named Chick Teazle. According to Teazle, Vido had fallen off once, lost his confidence, and fallen off four more times before he walked it successfully. Rick had aced it on the first run.

Valdez turned red and picked up his plate of food. He was raising it high, ready to throw it at Rick, when he realized that the room had gone quiet. People all around were watching and waiting. The rule had been made clear on first arrival: say what you like to each other while the tests were going on, but start a brawl and you were out. You'd be heading back where you came from on the next autobus.

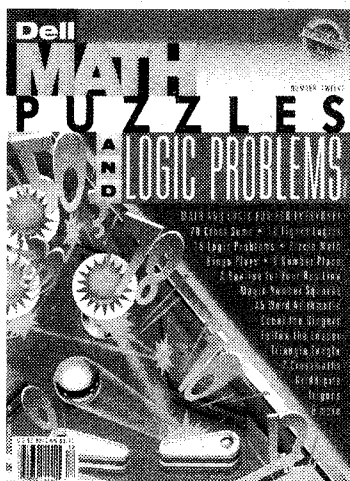
Valdez sat down with a bump and glared both ways along the table. "Don't get your hopes up, all you weenies. I'm stayin', and I'm winning." He stared at Rick. "I'll get even with you, Luban, soon as I have a chance. That's a promise. I'll beat the shit out of you. And I got a long memory."

"Your arms will have to be even longer—with you down on Earth and me up in space."

But Vido would not be drawn again. He picked up his half-filled plate, but only to stand up and carry it across to the disposal area. "Have some more food, numb nuts," he said to Rick as he left the table. "You want to be real well-fed for today's test."

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That got a laugh, but Rick did not know why. He glanced down to his own empty plate. It was a favorite of his, spaghetti and meatballs, and he had eaten two big helpings. The tests of the day were not announced in advance, but did the others know something that Rick didn't? Vido was a real pig, he went for multiple helpings and he *never* left anything uneaten on his plate. Except today.

Rick puzzled over that for the next couple of hours, while he struggled to assemble sets of blocks that had been cut into peculiar shapes. It looked easy, but it was curiously difficult. It didn't help when Chick Teazle stood up after less than an hour, the assignment all done. Vido Valdez followed twenty minutes later, giving Rick a smug look as he left. Rick managed to finish, just seconds before the deadline, but then he had to hurry at once to his next assigned location: Room B-2F.

Fortunately, he knew exactly where that was. He ran down two flights of stairs, along the corridor, and entered the room exactly on time. He had half expected to find Vido already there, but the room was empty. Rick looked around him with a good deal of curiosity. He had never been here before.

The room was one big cube. Walls, floor and ceiling were all alike, flat planes of smooth grey plastic. The only difference was the sprinkler system in the ceiling, what looked like a plastic observation window in one wall, and a set of drain grilles in the floor. In the exact center of the room stood a single piece of equipment. It consisted of three great hoops,

mounted with axes at right angles to each other but with a common center. They formed the outer skeleton of a great ball, four meters across. At the center of the ball, attached to the hoops by strong metal struts, sat a chair. It had solid armrests, foot supports, and a tall back, and loose straps dangled down from it. A short metal ladder led up toward it.

All this, for a test? Rick was walking forward to examine the structure more closely when Tess Shawm came into the room behind him. She was holding a black plastic coverall suit. "You've never had one of these before, I assume?" she said.

Rick shook his head. The hoops looked as though each one could swivel independently of the other two. As each hoop turned, the chair would turn with it. So the chair could face in every direction and at any angle, including upside down.

"Well, it's really pretty simple," Shawm continued. "Put this suit on over your clothes, and zip it up. Those big hoops on the test rig are on what's called *gimbals*, and they're independently driven by motors in the base. There's also a centrifuge effect. You know about that?"

"Sure." Rick knew that he had been told about centrifuges, back in school, but he didn't want to admit that he couldn't remember what they did. He slipped the black plastic suit on, and found that it fitted snugly and zipped all the way up to his neck.

"Good." Tess Shawm checked the top of the zipper. "You hear a lot about free-fall, and how it can upset your stomach. It can and it does, but it

turns out that almost everybody gets used to it after a while. A week or two in space, and you hardly think about it.

"Anyway, we can't easily test free-fall tolerance down here on Earth. What we can test, and what we're going to test today, is tolerance to changes in attitude and acceleration. There's a lot of individual variability in that from one person to another, and in space that actually causes more trouble than free-fall. Go ahead, climb up the ladder."

Rick thought he knew what was coming, and it didn't sound like a big deal. He had been on the wildest rides that the city's amusement parks had to offer, and he loved every one. According to Hoss Carlin and Screw Savage, Rick was like a rat. Mr. Hamel had once told them that rats didn't have any way to throw up, and that's why rat poisons worked in the school basement. The rats swallowed the bait, but they couldn't vomit it out.

Poison or no poison, though, the basement always seemed to have plenty of rats left.

He climbed up the short ladder with Tess Shawm right behind. "Put your forearms flat along the supports," she said, "and make yourself comfortable in the seat. When I fasten the straps, let me know if they feel too tight. They have to hold you in for any position of the chair, but they shouldn't be in the slightest bit painful. The head band stretches, so you can move your head forward if you want to."

Rick grinned at her as he leaned back so that she could place a broad band around his forehead. "That all

feels fine. Best seat I ever sat in. Like a king on a throne up here."

She gave him a peculiar look, and said, "'Uneasy lies the head that wears the crown.' Sit tight, your majesty. I'm going down to start the ball rolling. Call out if you want to stop—I'll be able to hear you."

She retreated down the stepladder, picked it up, and carried it out of the room with her. She closed the tight-fitting door. A few seconds later Rick saw her face at the observation window, high on one of the walls. He could not wave, but he gave her a big grin. She nodded back. A few seconds later there was a whine of electric motors and the chair began to tilt backward and to the left.

Gradually, the pace picked up. Rick could see the observation window, floor grilles, and ceiling sprinklers rotating steadily past him. He told himself that this was just another ride, one that he would have paid good money for a few weeks ago.

The walls were going past faster. Another component was adding to the motion. It was a curious, irregular backward-and-forward shift, as though the chair could not only rotate in any direction, but could at the same time be jerked up, forward and sideways away from the center of the hoops. Rick could feel new forces, pulling him every which way. It took a few seconds to realize that this must be the "centrifuge effect" that Tess Shawm had casually mentioned. It took less time than that for Rick to decide that he did not like what he was feeling.

Ceiling, walls and floor were turn-

ing into one continuous blur. He was no longer sure which way was up. Rick swallowed hard, and at once felt an urge to belch. He did so, and the sour taste of tomato paste came to his mouth. The vision of the mound of spaghetti that he had eaten swam before his eyes, and he tried desperately to think of something else.

All he had to do was yell, and the test would stop. Tess Shawm had promised it. The only thing that stopped him was the idea of how Vido would gloat next time they met. Someone had warned Valdez, he had *known* not to eat a lot. That wasn't fair.

Fair or not, Rick knew he could not stand much more. He was full of a terrible sense of dizziness, and the chair that held him seemed to swing and turn and veer faster than ever. His stomach felt three times its usual size. It was pressing upward toward his throat.

Stop!

Rick opened his mouth to shout the word. Instead of sound, a great gush of yellow vomit flew out and away. *Stop!* No word came. He leaned forward against the pull of the head band and threw up again, still unable to speak. When he closed his mouth, a sour jet spurted from his nose. When he opened his mouth again, the urge to retch made it impossible to breathe. He closed his eyes and hung against the chair straps in utter misery. As each new spasm hit him, he felt ready to die. And still he could not call out for it to end.

A sudden jolt of cold hit him in the face. He shivered and opened his

eyes—and found that he was sitting upright in a chair that was rotating horizontally and steadily slowing. Jets of cold water from the overhead sprinkler system were sluicing down, over him and all over the room. Streaks of yellow and red—his last meal—were steadily disappearing from walls and floor.

He leaned back, welcoming the chill of cold water on his forehead. Although his eyes told him that the chair was stationary now, when he closed them he was sure that he was still turning end over end. He was still dizzy and panting for breath. He had thrown up so hard that his stomach and his throat felt raw and strained. Even so, it was bliss just to sit there and think that, no matter how bad he felt, it was *over*.

He closed his eyes again. This time everything held steady. He did not move until he heard the outer door open and the clatter of the stepladder.

"Still feeling like a king?" Tess Shawm was ascending the ladder beside the chair. There was something different in her expression. He thought at first that she was gloating over his misery, and then he realized that wasn't it. For the first time, she was grinning at him as though he was a human being and not just a test subject. She released his right hand, and he raised it to wipe the wet palm across his mouth.

"I feel like shit."

"But you look like vomit." She freed the other hand, then his head. Last came the bindings on his legs. "Are you still dizzy? If you are, stay

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right there until it goes away. There's no hurry."

"I'm not dizzy—not any more. But I guess I really blew it."

She was frowning at him in bewilderment. "Blew what?"

"The test. I spewed my ring. Everything I had."

"Naturally. Take a look around you. Take a look at yourself."

Rick did so, first at his dripping coverall, then around the room. Every sign that he had thrown up had vanished.

"Why do you think the room was designed this way?" Tess went on. "And why do you think I put you in that plastic suit? You were *supposed* to throw up. Everybody does, every single person who takes it and passes. You only fail and blow it by shouting for me to stop too soon—for that, you lose all sort of points."

You don't know how close I came. If stomach hadn't beaten brain to it, that's exactly what would have happened.

"So you mean I passed?" Rick tested his balance, and found that it was all right. He stood up and put one foot on the ladder.

"More than passed." She hesitated, as though not sure whether to speak, and then went on, "I might as well tell you this, because given the grapevine in this place you'd know within a day anyway. You lasted longer than anybody else in this whole group. You must have an iron stomach. Congratulations. For this test, you stated it right at the beginning. You're the king."

The king. Sure. Rick didn't feel much like royalty as he stumbled away

on legs that were still a little shaky. It would soon be time for the afternoon meal, but he felt not in the least like eating.

He went instead to the dormitory, and was pleased to find it deserted. He lay down on his bed and closed his eyes. When he woke up what felt like two minutes later, he found that nearly an hour had passed and his stomach was empty and growling.

He went along to the dining room, determined to admit to no one what had happened in the test. That proved to be irrelevant. As he came into the half-filled room, Chick Teazle greeted him with a loud, "Hey, look who's here! The Vomit King."

The grapevine was remarkable—and Tess Shawm must be part of it. No one else could possibly know what Rick had said about feeling like a king.

He nodded at Teazle and took a tray without speaking. If they knew what he said, they must also know that he had done better than any of them. And somehow, even if it killed him, he was now going to eat a normal meal.

The food was a thick beef stew. The first three mouthfuls tasted sour and greasy, and as Rick swallowed he felt warning twinges in his stomach. Grimly, he kept going. When he was raising the fourth spoonful toward his mouth, Vido Valdez entered the dining hall.

Vido was walking carefully, on legs that didn't quite seem to meet the ground. His face, always dark, wore an added tinge of greenish-yellow.

Rick raised the spoon of glutinous brown stew toward him in greeting, flourished it in the air, and delivered it

carefully to his open mouth. It was gratifying to watch the progression in Vido's facial expressions, as they moved from anger and hatred to alarm and revulsion and nausea. He put his hand to his mouth, turned, and headed for the exit.

Rick chewed steadily. Suddenly, everything tasted 1,000 percent better.

Revenge is a dish best served cold. But it was all right to eat it hot, if it was beef stew and every spoonful made your sworn enemy turn a more striking shade of green.

The tests had gone on forever; and then, suddenly, they were over. The unsuccessful trainees vanished one evening, before the final results were announced. No one had a chance to complain, gloat or commiserate. The twenty remaining recruits were simply told the next morning that they would be going to space for additional tests and training.

No official rankings for performance were released, but somehow the word spread. Loudmouth Chick Teazle had done best of all. It was an unpopular result, making him seem even more obnoxious than before. Vido Valdez and Rick Luban, competing with each other more than with anyone else, had finished absolutely neck and neck. Neither had a chance to crow. Vido's dark face threatened future violence. Alice Klein, looking at the end of the course even thinner, paler, and weaker than at the beginning, had somehow squeaked through. Rick couldn't imagine how she had done it—he knew for a fact that she was not half as strong as him,

and she didn't seem well-coordinated or fast.

"She must have been screwing one of the testers," said Chick Teazle, standing in front of the electronic board where the list was posted. He brayed with laughter. Alice stared at him with those wide grey eyes, and thought unreadable thoughts.

Once again, the recruits had proof that Vanguard Mining did not waste time. That night there would be a celebration for the successful recruits—"Though what sort of a celebration can you have without drugs and booze?" Valdez grumbled—and the next day they would be on their way.

All twenty would travel together to the White Sands spaceport. Ten of the trainees would ship out first, traveling to a low orbit station on a single-stage-to-orbit vehicle. The other ten would join them forty-eight hours later, after the SSTO had returned to Earth and was ready to make its next ascent.

Dr. Alonzo Bretherton, who all through the tests had said hardly a word, joined them on the last evening and broke what they had begun to think of as his vow of silence.

"You may have questions," he said. "If you do, I'll try to answer them."

So far as Rick was concerned, that was easy. He had learned the rule long ago: The nail that sticks up gets the hammer. Nobody in his right mind drew attention to himself asking questions.

Apparently the other trainees had learned the same lesson, because there was a long silence. It was finally broken by a recruit already pegged by

Rick as out of control. She was short and brown and curvy, with enormous brown eyes, and she could never sit still or keep quiet. Her name was Suzie Roy Cruse, but everyone called her Monkey. Word said she had been kicked out of her school for running a professional sex service—inside its walls. She was supposed to be perpetually horny, but Rick had been too stressed out by all the tests even to think of trying her.

"Yes—Suzie?" said Bretherton, as she coughed and fidgeted and held up her hand. Rick was sure he had almost called her Monkey. If the rest of Vanguard Mining was anything like this place, secrets must be impossible.

Having shown that she wanted to speak, Monkey now seemed to be thinking better of it.

"You have a question about Vanguard Mining, and what you are going to be doing in space," Bretherton prompted.

"No." And when everybody laughed, Monkey went on, "I do have a question, but it's not about space. It's about *here*."

"I'll do my best."

"How come you keep males and females separated at night? And you run a curfew, and you *hit* people. One of the paramedics slugged me yesterday, just 'cause of something I said. That's against the law! I know we signed off on a deal that says you're like parents, but parents can't do that stuff. I could sue you, same as I could them."

"Are you planning to?"

"We-e-ell. I dunno. But I *could*."

"I'll save you the time and effort. You'd lose if you tried."

"I still got my rights. I never signed those away."

"Of course you have, and of course you didn't." Bretherton rubbed at his broken nose, and looked more like an old street bruiser than ever. "But you don't seem to know where you are. Can anyone tell Monkey where she is?"

There was another silence, while everyone stared at each other.

"We're at Vanguard Mining's medical facility, in New Mexico," Chick Teazole said at last. "Least, that's what the sign says outside the front fence."

"And it's telling the truth. But we lease our space from someone else. This land belongs to the Mescalero-Apache Sovereign Nation. You, Monkey, like me and everyone else, are governed by the laws of that nation while we're here. Their laws and civil rights are not the ones you're used to, but we like some of 'em a whole lot better. For instance, parental authority over children. Tess Shawm had every right to pop you one yesterday, when you told her she had great T&A and she'd make a good hooker. You're lucky that's all she did."

Monkey gaped at him. Rick felt that his suspicion was confirmed. Absolutely *no* secrets here, of any kind, and therefore no privacy. There must be hidden monitors all over, too small and sneakily hidden to be found and smashed like the ones at school. This place was like a jail—worse than a jail! Nobody would dare hit a prisoner in a jail, or he'd be up on a dozen charges and have civil liberty lawyers biting his ass before he could turn round. The sooner Rick was out of

here, the better.

"Does anyone else have a question?" said Bretherton at last. He had a grin on his battered face. "No questions? And no complaints? Well, then, let's get on with the party. I suspect it's the last one you'll have for quite a while."

He waved his hand toward a long table at the side of the room, loaded down with food and drink, and headed that way himself. Rick estimated the amount of food, counted heads, and made a decision. If he ran out for a quick trip to the john there would be plenty of everything left for him when he got back, and not so many people crowding round the table to get it.

He went in the opposite direction from everyone else, left the room, and headed along the white-walled corridor that led to his dormitory and beyond that to the men's room. When he came out, thirty seconds later, he could already hear laughter from around the corner. The fun hadn't taken long to start. He was hurrying back along the corridor when someone stepped suddenly out of the dormitory. Rick was grabbed by the shoulder, pulled into the dormitory, and spun back against the wall.

"In a hurry?" said a gruff voice.

It was Vido Valdez. Rick dropped into a defensive crouch.

"No fighting while the tests were on," Vido went on. "But that's all over now. Time for you and me to have a little talk, here where it's nice and quiet."

He was standing in front of Rick, hands raised. Rick knew from watch-

ing Valdez perform on the tests that he was fast. He was also a couple of inches taller, had a longer reach, and outweighed Rick by thirty or forty pounds. Rick assumed they both had plenty of street fighting experience.

The only good news was the lack of knives and guns at the Vanguard Mining facility. This was going to be straight hand-to-hand—or foot-to-foot.

As Vido came at him Rick braced himself against the wall and kicked out with his heavy-shod right foot. His target was Vido's testicles, but Vido sidestepped and grabbed for Rick's leg. He almost had it. The only way that Rick could make him miss was to hurl himself forward, using the wall as a push-off point, and slam into Vido's chest. His skull came up under Vido's chin, but it was not a clean hit. He heard a grunt and knew he had done no serious damage. That was confirmed when he was pushed away one-handed and Valdez's other fist came round to swipe him on the side of the head.

Rick jumped out of reach, ear ringing. He now knew for certain what he had suspected before: he could not compete with Vido for raw strength. And he was not sure he could compete on speed.

Valdez was coming in again, crouching to protect his head and testicles. Rick tried a stab with stiffened fingers at the eyes and only managed to hurt himself on Vido's hard skull as the other ducked. An uppercut from Vido missed, but a second later his other fist delivered a swinging round-house punch to Rick's other ear. For a second he could not see straight. The

only way he could be sure that Vido would not hit him again was to close in and grapple body to body.

He hugged Valdez and tried to butt him and knee him. At the same time Vido was trying to knee Rick in the balls. Their legs tangled together and threw them both off balance. Clutching each other, they fell to the dormitory floor. Rick's head just missed the solid metal leg of one of the beds, but he landed on top.

He heard the wind whoosh out of Vido. He tried to follow up with a punch to the solar plexus, but they were too close for him to get any real force behind it. And then Vido had him in a bear hug and was squirming around so that Rick was underneath. He fought to get back on top, and they went rolling over and over until they came to the wall.

Rick was the unlucky one. He was on top when they met the wall, but that meant it was his head that smashed into the cement with the momentum from both of them. He lost his hold on Vido and saw stars. The next thing he knew he was flat on his back, wedged in the angle between floor and wall. He could not get his left hand free.

Vido was sprawled on top of him. He gave Rick one solid punch on the left cheek, then skinned his knuckles on the wall trying to hook with his other hand.

He swore and grabbed Rick around the neck. His thumbs dug hard into Rick's throat. Rick bucked and jerked, but Valdez was too heavy and too well positioned. Rick could not dislodge him.

It was impossible to breathe. Rick groaned and gasped. His windpipe was constricted, the air passage cut off. He clawed at Vido's wrists but he could not break the stranglehold. The strength was going from his hands as Vido steadily throttled him. His full weight was pressing on Rick's chest. In another twenty seconds he became just a dark shape above Rick, squeezing ruthlessly.

And then suddenly he was gone. Rick, staring upward bulging-eyed, imagined a second and even bigger form looming over him. As he took in a first long and tortured breath, he saw that Valdez was standing in an uncomfortable crouch, one arm pinned behind his back and lifted toward his neck in a half-nelson hold. Vido was gasping in pain.

"I think that will do," said a cheerful voice. A huge hand came reaching down toward Rick. "Here, grab hold. Are you all right?"

Rick was far from all right—but he was not going to admit that to Doctor Bretherton, and still less to Vido Valdez. "I'm—I'm fine. Bit—short of breath. Guess I'm still not in—top condition." He straightened his clothes.

"Fine." Bretherton had been holding Vido helpless, apparently without effort. Now he released him, and Vido grunted in relief. "So all three of us can get back to the others. One thing, though, for both of you. You've had your fun now, so there'll be no more of this."

"Who told you what was happening?" Vido asked. He was rubbing his chin, where a bruise was already

forming. Rick decided it would be all right to massage his own sore throat and ears.

"Nobody told me," Bretherton said. "I saw it coming. I knew you two would be at each other sometime, the first minute I saw you. I'm glad you held off until the tests were over, though. It would have been a shame to kick you out. And I would have. There's no point in having rules if you don't follow them. But do it again here, and you're both history."

"So we don't get—get kicked out?" asked Rick.

"For a little fun? Of course not. What would a party be, without a bit of a fight?" Bretherton headed for the door of the dormitory. "It's time for me to get back there. You, too, but take time to catch your breath. There'll still be plenty of everything when you get there. Remember, though: it's over."

He was gone. Rick and Vido stared at each other warily. Doctor Bretherton was no longer in the dormitory, but his presence seemed to hang over the room.

"Better get back there," Rick muttered at last.

"Yeah. I guess."

They headed for the door at the same time and wedged into it together. Neither one was willing to give way. They turned, so that they were face to face and staring into each other's eyes as they edged through into the corridor.

Vido raised his fist toward Rick, then dropped it to his side. "You got away this time, Luban. He saved your hairy ass, and you know it. I'm not

dumb enough to do anything right now, not after what the doc said. But you better remember something, scumball."

His hand came up, to rub at his bloodshot left eye. "This ain't over. It ain't over 'til *I say* it's over."

CHAPTER FIVE

Weeks of mind-numbing tests, mental and physical, and the discomforts that went with them; they were all converging now, collapsing to a single and final minute.

Rick had been strapped into his seat for more than an hour. Next to him sat Deedee Mao, another of Vanguard Mining's recent recruits. Like him she had been expelled from her school at sixteen, but as he had discovered in the last hour of conversation they had little else in common. She and a dozen other trainees had been flown to the White Sands launch site from an East Coast medical test facility, two thousand miles away, to join Rick and the rest of his group. She was big, loud, and self-confident, just the sort of aggressive female that he hated. She and Rick had found themselves arguing almost from the first sentence. As the single-stage-to-orbit launch vehicle came closer to departure, however, they had both gradually quietened. For the past quarter of an hour neither of them had said a word.

That silence suited Rick. He didn't want to talk to *anybody*. He could not take his eyes from the changing digits of the display. *Sixty-two—sixty-one*. A siren began to wail inside the ship. Only one more minute to lift-off.

He knew, intellectually, that riding

the single-stage-vessel to orbit was not much more dangerous than taking a PV across the city. So why was he gripping the arms of his seat so hard?

There was an odd whirring sound and a vibration of the metal surface beneath Rick's feet. The hatch was moving to its final sealed setting. That meant that the lasers were powered up, waiting for their first discharge. The cover beneath the SSTO would have opened, to reveal the ablative layers.

Rick tried to concentrate on factual matters. The first minute would be the most uncomfortable. That's when he and Deedee and the eighteen other trainees aboard would feel the highest acceleration. After that the ground lasers would be switched off and the onboard nuclear rocket would cut in. The acceleration force on them would drop to two gs.

Thirty-two, thirty-one, thirty. . .

There were voices in the background: the ground crew for the ship, just three people. Their duties had been explained to Rick as part of the "informed consent" briefing.

The moving display in front of him seemed to have slowed, minutes passing between each second. Before he got here, Rick had imagined that travel to and in space would be conducted wearing spacesuits. The first White Sands briefing had taught him that was an idiotic idea, as out-of-date as the notion that aircraft passengers all wore parachutes. Rick was dressed in the same informal uniform of blue shirt and slacks that had become familiar to him since the day he arrived in New Mexico for the medical tests.

Twenty, nineteen, eighteen. . .

Almost as safe as a trip on the PV, the briefings said. But every day the media carried news of PV accidents. The vehicle he was sitting in felt far more vulnerable. Laser power could fail; the nuclear rocket could refuse to cut in; or it could refuse to turn off at the right time and hurtle the passengers away to oblivion. You could sometimes walk away from a PV accident. Had anyone ever walked away from an SSTO failure? There *had* been failures, he knew that for a fact.

Rick tried to steel himself for anything. He failed. It was with total astonishment that he suddenly felt a hand on his thigh.

You were supposed to keep your arms and hands flat on the padded seat support during launch. Rick turned. Deedee Mao was staring straight ahead of her. Her high-cheek-boned yellow face was oddly pale and rigid, but her fingers were squeezing and rubbing his leg.

"Wanna get it on when we're at the transfer station?" She could only be speaking to him, but he could hardly hear her or see her lips moving. "Y'know, in free-fall. I hear it's somethin' special."

It was the worst possible time for a sexual proposition. Even if he had known Deedee well, even if he had *liked* her, Rick was far too nervous to feel horny.

But he wasn't going to admit to her or anyone else just how he *did* feel.

"Sure." His voice sounded like an old man's. He cleared his throat. "Sure." Then he couldn't say any more.

Twelve, eleven, ten. . .

"I'll be in c-cabin t-t—" Deedee's fingers on his thigh were trembling. "Cabin t-t-twenty-eight."

Five, four, three—

"Oh, sweet Lord—"

Her hand was trembling worse. With fear, not passion. Rick felt an unexpected sympathy. Deedee was seeking distraction, anything to help her through the first seconds of launch.

"She's tracking," a crewman's voice said.

"Mirror's free."

Two, one. . .

Anything to help. And he needed distraction as much as she did.

Zero.

"Up ship."

As the final digit flickered into sight, Rick broke the rules, too. He lifted his arm from the padded support, placed his hand on top of Deedee's, and patted it.

Within half a second he knew that he had made the mistake of the century. Lift had begun. Deedee's hand and his own were suddenly welded together, pressed down by more than five gs of acceleration. His leg was tilted slightly upward and their joined hands inched up his thigh toward his groin.

Rick gasped with pain. If that monster weight kept moving up his body, it would turn him into a eunuch. He tried to lift his hand and arm and found them sheathed in lead. He could not raise *his* hand, let alone Deedee's. All he could do, with one desperate jerk, was push their hands a couple of inches away along his leg and hold them there.

The pain and pressure was excruciating. Deedee's whole forearm lay across his thigh. He could feel bruises forming there in real-time. He sat silent and sweating, pushing and pushing forever, until without warning all weight vanished completely. His stomach at once came free of its moorings and started to float up into his throat, but before he had time to gag he was again pressed back into his seat. This time the force was endurable. It had to be the two gs of the nuclear drive, but compared with the laser-boosted liftoff it felt like nothing.

Rick lifted his hand away from Deedee's, closed his eyes, and relaxed. After a few moments he felt her hand leave his thigh.

"Luban. That your name?"

"Yeah?" He opened his eyes and glanced across at her. Deedee Mao's smooth face was still pale but now it bore its old belligerent expression.

"Don't get no funny ideas, Luban."

"Like what?"

"I mean, about what I might have said back there at liftoff."

"I won't."

"I mean, I was just making conversation."

Rick couldn't let that pass. "Like hell! You were scared white. You should change your name from Deedee to Pee-Pee. You were ready to pee in your pants."

"Making love to you appeals less than screwing a swamp toad."

"I guess you've tried that. Tough on the toad."

She reached over and grabbed his arm. "Listen, if you want to have this out when we get to the station that's

fine by me. I've eaten smart-ass jerks like you—"

She paused. The steady roar beneath them had ended. Suddenly they were in free-fall, gliding upward in dead silence. Rick once more felt his stomach start to move up his throat.

"—Eaten them for break—" Deedee couldn't complete the word. Her brown eyes bulged and her mouth clamped shut. She turned away from Rick, reaching forward and trying to hold off long enough to get her suction mask into position.

Rick clenched his own teeth and closed his eyes again. He wished he could close his ears, too. Any smart-ass jerks that Deedee had eaten for breakfast were coming up again, along with everything else; and from the sound of it Deedee was just getting into her stride. Rick didn't want to watch.

Sex in free-fall—or fighting, or anything else with the possible exception of dying—didn't seem to be in Rick and Deedee Mao's immediate future.

Rick had been told quite a few things about Vanguard Mining's operations, but he lacked the glue to put the pieces together. For instance, he knew from the short briefings at the medical facility and at White Sands that franchises for commercial mining of the Belt had bogged down in endless debate within the Council of Nations. That deadlock had continued until the Council's own international (and multilingual) mining effort had ended in disaster, with the loss of all equipment and personnel.

At that point, business interests

were suddenly permitted to mine the asteroid belt—and welcome to it. The Council had decided that there was no profit to be made there, although they were more than ready to accept franchise fees. They were astonished when Vanguard Mining's prototype mine and refinery turned out to be profitable. In the subsequent sixteen years the company had established commercial mining and refining operations on thirty-eight different asteroids out in the Belt.

Rick knew all that. He had also been told, at the time of his first tests by Vanguard, that the woman speaking to him was located on some place called CM-2, in translunar orbit. But in school, astronomy had been of no interest. He didn't know the difference between LEO and GEO, or cislunar and translunar. He was more interested in chastity belts than asteroid belts.

It never occurred to Rick to connect the things he had been told until the translunar transfer vehicle carrying him and thirty-one other trainees up from the holding station in low Earth orbit was close enough for Rick to actually see CM-2.

He had been expecting some sleek, clean-lined structure. Instead he found their vehicle was closing on a vast irregular lump of dark rock.

"That thing?" Rick spoke to Deedee, who was between him and Jigger Tait, a Vanguard miner who was hitching a ride back from Earth with the trainees. "That can't be the training center."

In the two days since first lift-off, Rick and Deedee had been observing a sort of armed truce. Their ship, station, and dining-area seat assignments

had forced them to be together most of the time, but neither one was sure enough of either knowledge or stomach stability to risk an assertion of superiority. So it was Jigger, big-boned, iron-stomached, unaffected by free-fall, and apparently totally self-confident in every way, who raised his pale eyebrows, sniffed disdainfully, and said, "Don't you guys know *anything*? That's CM-2 out there—commercial mine number two."

"But I thought the mines were all out in the Belt."

"They are. But this one has been worked out commercially. When the iron and siderophiles—that's nickel and platinum and iridium—were all gone they attached low-thrust engines and moved it to translunar, so now it's the headquarters for the Vanguard training school."

"I don't remember that from any briefings." Rick looked questioningly at Deedee, who shook her head.

"Me neither."

"Then you didn't use the browse feature on your reader."

"We weren't told we had to."

Jigger sniffed again. "I'm sure you weren't. But I'll give you some free advice that I had to learn the hard way when I was a trainee: If you only do what you're *told* to do, you'll soon be in trouble at Vanguard Mining." Jigger lifted from his seat, moving effortlessly in the zero-g environment. "OK kids. Better get your act together and strap in. We'll be docking in a few more minutes. But before you sit down, take a quick look at that."

He pointed outside, away from CM-2. At first Rick saw nothing but bright

unwinking stars. He stared hard, and finally noticed something like a tiny feather of sparkling blue-white where Jigger Tait had pointed.

"What is it?" asked Deedee. "A comet?"

"No such luck. That, friends, is the competition. Take a good look, and hope you won't be seeing a lot like it."

"That's a *ship*," Rick exclaimed. "Isn't it?"

"It is. But it's not one of ours, you can tell that from the drive. They use pulsed fusion, we use continuous fusion. So their ships don't show a continuous exhaust. If you want to travel rough, ride one of those babies—an acceleration that varies between zero and two gs and back, every ten seconds."

"What do you mean, not one of ours?" asked Deedee.

"What I said. That's part of the fleet of Avant Mining and Refining."

"Who?"

"God! Don't they tell you guys *anything*?" Jigger glared at them. "Avant Mining and Refining. Founded seven years after Vanguard. They're aggressive, expanding fast. That one's on its way back from the Belt. Did you think we had a damned *monopoly* out here?"

"Nobody ever mentioned Avant Mining," said Deedee defensively, and looked at Rick for confirmation. He nodded.

"Well, they will," Tait said. "Maybe you shouldn't hear this from me, but you're going to find it out sooner or later. Avant makes our management real nervous. They've had a couple of big successes in the Belt, places

where they got to a rich asteroid and staked their claim on it before we did—even though we thought our prospectors had found it first, and we had the inside track. Believe me, Avant is *tough*. Pacific Rim financing, and they play real hardball. You'll see."

He floated away toward the rear of the ship. Rick and Deedee lingered at the screen for a few seconds longer, staring at the insignificant mote of Vanguard's competition. But then their attention turned again to their destination. CM-2 seemed much more important to their immediate future than Avant Mining.

Now that they were closer they could see the true size of the training asteroid. Each of the wart-like bubbles that covered the surface of the planetoid was actually the exit point for a mine shaft, three to ten meters across. The whole object must be riddled with tunnels. CM-2 seemed more like a whole world than a training facility.

The now-familiar warning siren began to wail. Thrust was coming in sixty seconds. Rick led the way back to their seats, striving to mimic the easy free-space motion of Jigger Tait. He couldn't do it. After a few seconds of aimless drifting he was forced to pull himself along using seat backs as handholds. Convinced that Deedee was watching him and laughing, he

turned his head. She had just bounced off a wall and was turning end-over-end with a bewildered expression on her face. He went back and helped her to reach her seat.

One thing about free-fall, Rick thought as they reached CM-2 and went through docking, pressurization, and disembarkation: it made you a lot less likely to laugh at somebody else—because you never knew how soon your turn would come to look like an idiot.

As he left the pressurized dock he turned and caught a glimpse of Earth through the transparent overhead dome. It hung above him, about twice as big as a full Moon.

He halted and stared up at it for a long time. Somewhere on that globe was his school, with Screw and Hoss and Juanita and Jackie, with Mr. Hamel and Mr. Preebane and Principal Rigden. Somewhere were his mother and Mick, living it up on what they had been paid by Vanguard Mining—unless it was already all spent. Somewhere were Doctor Bretherton and Tess Shawm, taking in the next batch of recruits and testing them to the point of collapse.

They were all on that far-off blue-grey ball, all invisible, close to each other in space but seven hundred thousand kilometers away from him.

It felt more like seven hundred million. ■

TO BE CONTINUED IN THE NEXT ISSUE.

H. Paul Shuch, Ph.D.

SETI MADE SIMPLE: WHAT CAN WE DO?

Introduction

There are many things which excite me about the times in which we live. One is that I have been privileged to witness a perceptual paradigm shift. Just 50 years ago, every credible authority maintained that humankind is alone among the stars, the sole sentient species in the vast cosmos. Today, the overwhelming preponderance of scientific thinking holds that we are not. How quickly we have completed the Copernican revolution!

In these pages, we will explore the pertinent cosmological evidence which leads most knowledgeable scientists to envision a Universe teeming with life. We will see why many astrophysicists believe that the best evidence of extra-solar civilizations is to be found in the microwave spectrum. I will posit that, if these lines of thinking are correct, it is the radio amateurs and microwave experimenters of planet

Earth who have the best chance of detecting such evidence. I will lay out a strategy for amateur SETI,¹ a Search for Extra-Terrestrial Intelligence involving several thousand hobbyists which can rival any government search ever proposed and denied funding. Finally, I will list the equipment requirements for you to join the team, the microwave, computer and digital signal processing hardware and software which would make a planet like our own visible from across the Galaxy, and which is today within our grasp.

So Who is SETI?

Contrary to popular belief, a SETI is *not* a specific breed of intelligent alien invading our planet. The acronym for *Search for Extra-Terrestrial Intelligence* was coined in the 1960s, to de-

1. The SETI League, Inc., P.O. Box 555, Little Ferry, NJ 07643. (201) 641-1770. E-mail: n6tx@setileague.org

scribe the use of radiotelescopes to seek out electromagnetic signals of possibly intelligent origin, emanating from beyond our planet. Dozens of such searches have been conducted over the past 35 years, with some interesting results, none yet conclusive. On the other hand, not only have we not yet scratched the surface, we haven't even found the itch. We *have* surveyed several thousand stars, for brief periods of time, at limited frequencies. But with an estimated two hundred billion stars in our Galaxy, and perhaps a hundred billion other galaxies, we have a long way to go before we can start drawing any conclusions.

In fact, logic and probability theory suggest that we should *not* have yet succeeded in receiving intelligent signals. SETI pioneer Dr. Frank Drake, who conducted the first search in 1960, now estimates that there are

perhaps 10,000 advanced civilizations in the Milky Way Galaxy.² That makes each star we survey a 20-million-to-one long-shot. To have found the elusive needle in the cosmic haystack by now, would be equivalent to walking into the Library of Congress blindfolded, selecting one book at random, and getting home to find that we had checked out *Macbeth*. If we try, and fail, does that mean that *Macbeth* does not exist? The data is incomplete.

Then again, our elected leaders are hardly averse to drawing conclusions from incomplete data, and acting upon them precipitously. For a while NASA had a modestly funded SETI office, receiving perhaps a tenth of a percent of NASA's budget. Both a targeted search of likely candidate stars and an overall sky survey were initiated in October of 1992 (significantly, the 500th anniversary of Columbus's



first voyage of discovery). Failing to produce immediate results, NASA's funding was suspended by Congress just one year later, and both searches curtailed. The SETI League, SETI Institute, Planetary Society and other organizations are now trying to privatize those efforts.

The SETI League, which I am privileged to head, was founded in 1994 as a membership-supported, non-profit [501(c)(3)] scientific and educational corporation. Our charter involves organizing and conducting an electromagnetic search of the skies, to spot signals of possible intelligent origin. This search will involve thousands of radio amateurs, microwave hobbyists, and Digital Signal Processing experimenters around the world, working in concert to accomplish the seemingly impossible.

Cosmic Evolution

Let's keep this brief. Current thinking, as first theorized by George Gamow, holds that the Universe began as a single, incredibly dense point in space-time, which exploded perhaps nine to eighteen billion years ago, and has been expanding and cooling ever since. Gamow's evidence in support of this theory was the consistent red-shift (decreasing frequency Doppler shift) which Edwin Hubble had measured in distant galaxies. Fred Hoyle derisively dubbed

that universal birth event the Big Bang, and the name stuck. Gamow's theory further predicted that the Big Bang should have left a residue of microwave radiation, which was indeed first measured by Arno Penzias and Robert Wilson in 1965. The so-called Three Kelvin (3K) Background Radiation has been reaffirmed countless times, and stands as the best evidence to date of an expanding Universe.

Our uncertainty as to the exact age of the Universe stems from our inability (thus far) to precisely measure the Hubble Constant, which relates to the rate of expansion of the Universe. Recent measurements from, appropriately, the Hubble Space Telescope are bringing us closer to an answer. It seems that every week some astronomy team produces yet another estimate of the Hubble Constant. In fact, I've lately taken to calling it the Hubble Variable.

We do have evidence to suggest, however, that our planet is on the order of four-and-a-half billion years old. Thus, regardless of which estimate of the Hubble Constant we accept, the Earth appears to be only half to one-fourth the age of the Universe. This is significant, because it suggests that our planet (and the star around which it revolves) are youngsters, relatively new arrivals on the cosmic scene.

Our rather ordinary star is but one of perhaps two hundred billion in its Galaxy (which we call the Milky Way), and perhaps a tenth of those stars appear to be of similar size, heat and composition to our Sun. Although we cannot detect planetary systems optically,³ they evidence themselves in several other ways, and everywhere we

2. Drake bases this estimate on his personal solution for the Drake Equation, an elegant tool for quantifying our ignorance, which he developed in 1961 as the agenda for the world's first SETI conference. Today the Drake Equation is a classic, to be found in nearly every astronomy textbook which addresses the question of alien life.

have looked for planets, we have detected what we believe to be indications of their presence. It is theorized that the formation of planets is an essential process by which a rotating star dissipates some of its angular momentum. So planetary formation appears commonplace, and we can assume that each of the Sun-like stars in our Galaxy has its own retinue of planets. Since the stuff from which our planet is made is hardly unique to Earth, but common throughout the cosmos, we can expect at least some of those hundreds of billions of planets to have a rocky crust, liquid oceans, and puffy clouds in nitrogen skies—what Star Trek calls “M-class planets.”

Finally, our Galaxy is one of perhaps a hundred billion such star groups in the Universe. Now there's no reason to expect the laws of physics, or chemistry, to be different in those other galaxies, from the ones we observe on Earth. Which leads us to imagine the existence of billions of Earth-like planets circling Sun-like stars. And remember, most of those planets are older than our homeland, and have had more time to spawn their particular versions of life.

The Emergence of Life

Perhaps the most amazing aspect of our existence is that *life evolved from non-living things!* Our tissues derive from not just any non-living things, mind you, but a specific group of complex organic molecules called amino acids. Of course, we have no

way of knowing that life on other planets is necessarily “organic” as we use the term, but let's assume for just a moment that it is. (If we're wrong, this suggests the existence of more, not less, life than I am supposing.)

One of the most important contributions of radioastronomy is its ability to discern the composition of its target objects. Not just stars (which we know to burn primarily hydrogen into helium); radiotelescopes can measure the composition of interstellar molecular clouds as well.

The presence of abundant interstellar hydrogen was first detected by Harold Ewin and Edward Purcell in 1951, by measuring its 21 cm microwave emissions. In 1963, a group at MIT's Lincoln Laboratory first detected the characteristic 18 cm emission of interstellar hydroxyl ions. We shall learn shortly about the significance to SETI of these two spectral emission lines. Less well known, but even more important for discussions involving the origin of life, is that dozens of complex molecules, many organic, have also been detected in the interstellar medium. A partial list: cyanogen, ammonia, water, formaldehyde, carbon monoxide, hydrogen cyanide, cyanoacetylene, methyl alcohol, formic acid, carbon monosulfide, silicon monoxide, carbonyl sulfide, acetonitrile, isocyanic acid, methylacetylene, hydrogen isocyanide, acetaldehyde, thioformaldehyde, methylenimine, deuterium cyanide—the interstellar medium is anything but an empty void. It is a veritable chemistry set.

But can it spawn life? Nobel chemist and SETI pioneer Melvin Calvin be-

3. Optically viewing a planet orbiting a star is a little like trying to spot a firefly perched on the rim of a searchlight.

lieved so. At Berkeley in 1951, he sparked a mixture of carbon dioxide, hydrogen, and water with an energy burst from a cyclotron, and produced organic chemicals, some of which are known to be precursors of life. In 1955, Miller and Urey at the University of Chicago restructured the Calvin experiment with an even more startling result: using several of the precursors from the above list, they produced a wide variety of amino acids!

If solar systems indeed condense out of the interstellar medium, then the chemicals of life may be found on countless planets. Necessary energy sources (lightning, volcanism, whatever) are readily available. Building amino acids appears relatively easy. In fact "alien" amino acids have already been found in meteorite fragments, so we know they are commonplace in the cosmos, by no means unique to Earth. Now it's a long step from amino acids to living, thinking beings capable of harnessing electromagnetic communications (and hence detection by our radiotelescopes). On the other hand, the number of potential life sites in the Universe is truly mind-boggling. If we take the Milky Way to be typical, there are on the order of a million billion billion "good" suns among the galaxies. Should life not have evolved on planets orbiting a good many of those suns? If an infinite number of monkeys sits down at an infinite number of typewriters, one of them is bound to write out the whole Encyclopedia Galactica.

How to Search

We don't know for certain that all

species eventually develop electromagnetic communication, but we're betting that some do. Photons are, after all, the fastest spaceships we can imagine. Radio communication is cheap, quick, and easy to learn. If we can figure it out, the assumption of mediocrity suggests, then so can more advanced civilizations, who may have been around millions, perhaps billions, of years longer than ourselves. OK, so maybe a given technologically advanced civilization adopted, and then abandoned radio communications a billion years ago. No matter. If they are a billion light-years distant, their photons are just now reaching us, and are in fact falling silently on our heads even as we speak.

The greatest obstacle to interstellar communication is naturally occurring noise. Galactic, cosmic, quantum and synchrotron noise sources span the spectrum, but they are not uniform. The quietest part of the sky, the 1 to 10 GHz microwave window, is a logical starting point, and by no means geocentric. But we're talking an incredible bandwidth here. Can we narrow the search spectrum?

Most SETI scientists think we can. Toward the bottom of the microwave window are two rather strong spectral radiation lines, emanating from hydrogen and hydroxyl, among the most abundant substances in interstellar space. It has long been suggested that between these two markers falls a natural, universal communications band.

Significantly, hydrogen and hydroxyl are the disassociation products of water. Although we need not limit our search to water-based life, it's interest-

ing to speculate that others might recognize an additional significance to these two frequencies. Dr. Bernard M. Oliver headed NASA's SETI office until it was closed. It was Oliver who, in a 1971 study,⁴ first suggested scanning the cosmos between the hydrogen and hydroxyl lines. He coined the rather poetic term for this proposed communications

band. "Where shall we seek out our kind?" Oliver asked. "At the water-hole, where species have always gathered."

Other frequency bands than the water-hole, and other technologies than microwave, are certainly worthy of SETI consideration. In fact, a good deal of attention is being paid to Optical SETI, by optical astronomers who, after all, do have a 400

year head start on their radio counterparts. But the SETI League was founded by radio amateurs, and radio waves are what the ham community knows best. Thus it is here that we are con-

centrating our amateur SETI efforts.

The water-hole extends from roughly 1420 to 1660 MHz, a bandwidth of 240 MHz. Monitoring it at, let us say, 10 Hz resolution, we have 24 million channels to scan. So much SETI research has been devoted to developing mega-channel real time spectrum analyzers. This can be approached as a

digital signal processing project, an area in which hams are emerging as the technological innovators. A personal computer sound card, for example, may not be capable of scanning the entire water-hole in real time, but it can certainly cover audio bandwidths, at reasonable resolution, with astounding sensitivity. Given the appropriate accompanying software, there's no reason



The author seen here with 5-meter (left) and 3-meter satellite TV dishes repurposed for amateur SETI. Photo by Beth Shoemaker. Williamsport (Pa.) *Sun-Gazette*, used by permission.

not to believe such systems capable of recognizing very weak coherent signals coming out of our microwave receivers.

The late NASA SETI study had two complementary components, a targeted search and an all-sky survey. The former, involving parking on likely candidate stars for long periods of time, is well suited to large, steerable dishes with their narrow beamwidths and high sensitivities. If we guess right as to which stars are likely candidates, the targeted search will provide us with the greatest likeli-

4. That study, part of a summer faculty fellowship program at Stanford University, brought together some of the leading minds in radioastronomy, to puzzle the problem of interstellar communications. The group's most tangible result, the Project Cyclops report, remains one of the most important SETI publications to date. Although it is currently out of print, the SETI League hopes to make it available to interested SETI newcomers.

hood of immediate success. But since only a limited number of relatively nearby candidate stars is known to us, concentrating our search in their direction may cause us to miss an equally good star of which we happen to be unaware.

An all-sky survey, on the other hand, makes no *a priori* assumptions as to the most likely direction to explore. The sky survey attempts to sweep out the entire sky which can be seen from a given location. No antenna tracking is required, since it is sky, rather than individual stars, which we seek to survey. Therefore, we can employ our antennas in virtual transit mount mode, as Grote Reber did when he invented the radiotelescope,⁵ by aiming them due south, letting the Earth turn them, and varying only their elevation.

Since large antennas are quite narrow, the sky survey is better performed with dishes of moderate size. Smaller antennas of course have less gain, so to achieve reasonable sensitivities, they need to scan for extremely long periods of time. The sky survey approach, it would seem, is ideally suited to the community of radio amateurs and microwave experimenters. This is the area in which I

feel that amateur radioastronomers can make their most significant SETI contributions.

What Can We Do?

The beauty of SETI is that there is something for everyone, enough work to spread around. And if we succeed, it will not be one individual, but all of humankind, to whom the glory will accrue. What I intend to show you here is that, should we succeed, it will be due not to any individual effort, but to the cooperative efforts of thousands of dedicated amateurs.

Have you perhaps recently upgraded to the new digital Direct Broadcast TV service, with its tiny Ku-band dish? Are you now wondering what to do with your big monster C-band TVRO dish? Have we got a deal for you! Consider that the average satellite TV dish has a beamwidth on the order of 3 degrees at water-hole frequencies. Let's put that dish on a transit mount, and let the Earth be our antenna rotor. Now the dish will be rotating at 15 degrees per hour, which means a given star will be within its beamwidth for about 12 minutes. Given existing amateur digital signal processing (DSP) technology, and employing a few tricks, 12 minutes is enough time to thoroughly scan about 14.4 kHz of spectrum, at 10 Hz resolution (which I consider consistent with the frequency stability of amateur microwave local oscillators). But the water-hole is 240 MHz wide, which means to cover our assigned three-degree swath of sky at all water-hole frequencies, we need to be listening for just 16,667 days. That's a little over 46 years.

Well, perhaps a dedicated experi-

5. Reber, an electrical engineer and radio amateur (W9GFZ), built the first true radiotelescope in his backyard in Wheaton, IL, in 1937. Although lacking in formal astronomical training, he is today recognized as the patriarch of a new discipline. His 10 meter diameter dish (slightly larger than the size which I propose for amateur SETI), on a transit mount, generated the first radio map of the sky. Reber measured radiation levels millions of times in excess of what then-favored theories predicted. His controversial measurements have subsequently been borne out repeatedly.

menter will be willing to devote 46 years of his life to studying the sky. Tycho Brahe did. But a 46 year search at a single antenna elevation will only survey a three degree wide swath of sky. To cover the range of declinations from southern to northern horizon, we need to conduct 60 such surveys, which brings the time dimension of the effort up to about 2,760 years. And that only covers what we can see from our location. Depending on our latitude, this could be as little as half the sky. A complete sky survey might demand we spend this long searching from each hemisphere. So a dedicated amateur can complete one full sweep of the water hole, in just under six millennia!

On the other hand, 5,520 experimenters can do that same sky survey in just one year. Which is why it becomes important to make SETI a broad-based effort. And where but in the amateur radio service are we likely to find several thousand dish-equipped experimenters, scattered around the globe, with the means to communicate, hence coordinate their efforts? I submit that the problem might have been tailor-made for us.

It is my belief that radio amateurs and microwave experimenters, with our limited equipment but high level of dedication, have every bit as much likelihood of success as do the world's great radiotelescopes, in detecting extraterrestrial signals of possible intelligent origin. It is, after all, amateur optical astronomers who first detect the majority of comets, and radio amateurs who have pioneered most all of modern telecommunications technology. And what the scientific establishment

has in the past regarded as impossible, dedicated radio amateurs will doubtless accept as just another challenge to be met.

What do you need to join the search? A three to five meter parabolic reflector, with surface smoothness adequate for satellite TV, or microwave moonbounce.⁶ A low noise preamp which covers the 1.4 to 1.7 GHz range. A microwave downconverter (we're hard at work now designing simple kits to fill this niche) to shift the water hole down to VHF. A VHF scanning receiver (of perhaps the Radio Shack variety) to tune the shifted water-hole. A digital signal processor (such as a SoundBlaster card). Spectrum analysis software, and a home computer on which to run it. What you don't build can be purchased at a cost on par with a typical ham station. Several hundred stations are already so equipped. By the turn of the century, perhaps several thousand, and then—who knows?

I like to view the SETI problem as an equation with four degrees of freedom: Sensitivity, Frequency Coverage, Sky Coverage and Time. The amateur quest which I propose will of necessity be weak in the first variable, moderate in the second, but extremely strong in the third and fourth. Using readily available technology, a few thousand dedicated amateurs around the world can, in 20 years' time, repeatedly scan all 4π

6. If you don't want to dedicate your dish full-time to the SETI effort, no problem. A water-hole feed certainly doesn't preclude installing other feeds at the focal point as well. You can practice what's come to be known as Parasitic SETI, letting your water-hole receiver scan while your dish goes about its daily business of ham radio, TV, or whatever.

steradians of sky, over the entire water hole, to ten Hertz resolution, at sensitivities which rival NASA's late High Resolution Microwave Survey.

I expect some kind of coordination to be required, and that's where The SETI League, Inc. comes in. We are a tax-exempt, nonprofit scientific and educational corporation devoted to keeping the search alive. Our mission involves research, economics, and more than a little politics. We will encourage restoration of NASA's SETI funding if possible, help to privatize the effort if necessary, coordinate the efforts of a wide range of SETI amateurs and professionals, and educate the public as to the possible benefits of the search. We also stand prepared to assign participating amateurs specific search declinations, so as to assure full sky coverage, and will act as a clearinghouse for information and results. I'm sure once one suspicious signal is detected, everybody will want to know where to point his or her dish to help confirm it! The Information Superhighway is an ideal coordination means, and we're already establishing ourselves as a

presence there. If you have World Wide Web access, feel free to check out The SETI League's home page, at <http://seti1.setileague.org/homepg.html>.

A broad membership base will make it possible to put amateur SETI on track. We plan to publish and promote the best hardware and software schemes to come out of the ham community, and will design, prototype and evaluate various detection and signal analysis technologies. We hope to officially "launch" our all-sky survey on Earth Day, April 21, 1996. But don't wait 'til then; there's much work to be done in preparation. If you wish to put a station on the air, we'll be happy to assist. If you do not, but wish to experience the vicarious thrill of discovery, you're still welcome to join us.

To receive further information on joining The SETI League, call 1(800) TAU-SETI, or e-mail to info@setileague.org. In the immortal words of Rick Blaine, "If that call comes, and you don't answer, you'll regret it. Maybe not today, maybe not tomorrow. But soon, and for the rest of your life. ■"

About the Author

H. Paul Shuch is an aerospace engineer and educator, with a Ph.D. in engineering from the University of California, Berkeley. He has taught electronics and aeronautics at various colleges and universities for more than twenty years. Dr. Shuch is currently on leave of absence from his position as professor of electronics at the Pennsylvania College of Technology, in order to serve as the first executive director of The SETI League, Inc. His teaching and research have won numerous national awards. He is the author of over 100 publications, is credited with designing the world's first commercial home satellite TV receiver, and invented the patented BiDCAS aircraft collision alert system. Paul is listed in *Who's Who in Science and Engineering*, *Who's Who in American Education*, *American Men and Women of Science*, and *International Directory of Distinguished Leadership*.

James White

UN-BIRTHDAY BOY

*"Normality" involves comparison to a standard—
but how do you judge the standard?*

Every morning he tried very hard not to waken into his unhappy world, but the wall beeper would only get louder until he turned it off to let his mother know that he was awake and would be out for breakfast as soon as he had washed and dressed. The voices of the three other children came through the adjoining wall, louder and more excited than usual because today was Danal's birthday and there would be a party and presents. He especially hated waking up on a birthday because those days were the unhappiest of all for him since he had never had one.

He was the only member of the family with his own room, he thought as he cleaned himself all over with the special sponge that was supposed to help take away the smell that they all said came from his body, then he deliberately looked out of the window while he dressed. Not so long ago he had needed his mother or one of the other children to help him with his fastenings, but now he was able to dress and look outside at the same time. Even his father, while visiting his

room to do nasty things to him, had said that he was showing a change for the better and that it was about time. But there was never any change in the view from his window, just the same haze of stars moving past like banks of bright speckled fog and the sun-shadows moving slowly along the metal framework that held their house to the rim of the spacestation.

All at once the other room became quiet and empty. He waited for as long as he could then followed the others into breakfast before his mother could come in to ask him if he was feeling sick again.

It was the fourteenth birthday party that he had attended, five for each of the two older children and four for the youngest one who was his favorite, although there might have been others that he had been too young to remember. They always began at breakfast time so that his father could join in and distribute the presents before dressing for work. Because it took so long to get into and out of a spacesuit and to check everything, the children would not see him again until it was nearly bedtime. His

father spent the last hour of the day playing with the children in their rooms, but some of the things he did to him when they were alone together were not nice so that he would have been pleased not to have a father at all.

"Since this is another birthday," said his father, smiling at everyone in turn, "we have again been given permission to let you spend today playing in the Center. Your mother will stay with you until I finish for the day and we come back for another party. This time the area of wall netting has been extended and the metal projections padded so that there is no risk of you injuring yourselves. But don't get overexcited or jump off too fast because a collision at speed with the net supports or each other will hurt and would certainly spoil the rest of the birthday for you. And if someone was to be seriously injured you might not be allowed to play in the Center again. So be very careful, all of you."

Why, he thought, does he always look at me when he says things like that?

"And now," his father went on, "the presents. . . ."

Danal, the birthday boy, was given his present first. It was a large box wrapped in used computer paper, and while he was opening it his younger brother Cawn and sister Wana were given smaller presents so that they would not feel bad because it wasn't their birthday. It wasn't his birthday, either, it was never ever his birthday, so he was given a present as well. It turned out to be a well-worn, animal soft toy, a castoff that had been

given to Wana when she had been only two.

He said "Thank you," like the others, and put it down beside his bowl even though he wanted to pull its legs off and throw it at them. When he saw the nice things that the others were getting he tried not to speak, but the angry words came out anyway.

"Why don't *I* get presents like that?" he said, waving his arms and almost knocking over the food bowl as he tried to point at all of them at once.

"This thing is for, for babies! Why don't you give *me* toys and games that light up and make noises and do things? You don't want me here. You don't love me, not like the way you do the others. I heard them talking about it. You, you don't even give me nice things to eat!"

This time it was little Wana who pointed. She was the youngest and smallest of the children and she always talked to him as if he wasn't stupid. With her tiny hand almost touching his face she said, "Why are your eyes all wet?"

"Of course we love you like the others," said his mother. "It is just that—"

"—It isn't easy to have toys sent 'way out here," his father joined in. "There are weight restrictions on non-essential supplies for personal use, and we have to take good care of them. If you promise to be very careful and not lose your temper if the game is too difficult, Danal or Cawn will let you play with one of their old ones until you're able to—"

"No!" said Danal in a very loud voice. "I let him play with a game last year, remember? It was a flight simulator, an old one but still working, and he smashed it into bits before bedtime. He has hands like clumsy feet and he talks funny and he's got a big head with no brains in it. I won't do it, I won't."

"Me, too," said Cawn in a quieter voice. "He always breaks things. He's rough and he's not like us and we don't like him. Why don't you just send him away?"

"Stop talking like that, right now," said his father, "and listen to me. He can't help what he does and maybe he will learn not to break things one of these years. Maybe it was the accident when he was a baby, or being so long in that survival pod with not enough food in the dispenser that made him slow-witted. He was nearly dead when we found him. You have to make allowances for him not being. . . ."

An argument started between his mother and father and the two boys; the same argument that happened at every birthday party for as long as he could remember. It made him feel very bad. He was wiping his eyes with his fingers when Wana leaned sideways in her chair towards him.

"I like you," she whispered. "I don't want you to go away. I think you're nice and fat and cuddly, and you've got a big, funny head."

All at once he felt a warm, sad, glad feeling that made his eyes get wet again, but he could not find the words to tell her about it. The argument was still going on between Danal, Cawn, and his parents, but it stopped when

his father stood up.

"Enjoy your presents," he said. "It's time I left for work."

"Coward," said his mother, rising to go to the door with him. The boys stopped arguing and went back to exploring their presents and deliberately ignoring him. He was staring down at the old soft doll when he felt Wana's fingers poking into his arm.

When he looked at her he saw that she was watching the two older boys and pushing her bowl sideways towards him. It was still half-filled with big, flat, pieces of yellow and red fruit floating in thick juice and his mouth watered just looking at it.

"Thank you. Wana," he said, reaching for the bowl. "Would you like some of mine?"

She looked down at the gray, lumpy contents of his bowl and said, "Yuk."

"Me, too," he said.

He had succeeded in making one of the pieces of soft, slippery fruit stay on the spoon and was lifting it carefully to his mouth when his mother came back and started scolding everybody except him.

"Don't let him eat that!" she said. "How many times have I told you not to give him any of your food? He has an allergy to fruit and practically everything else in this place. Don't ask—an allergy means that certain things make him sick or brings him out in itchy spots. Wana, don't ever give him your breakfast again. And you boys are old enough to know better. Why didn't you stop her? Go into the living room and play with your toys. Leave the door open so I can hear what you're doing. . . ."

From the living room he could still hear her talking to herself as she cleared the breakfast things. The two boys were playing with the new game Danal had been given for his birthday and they did not look at him. Wana had brought out the old teaching game that all of the others had used when they were younger, a flat box that showed moving pictures on top while a voice inside explained what was happening in very simple words.

"Thank you, Wana, anyway," he said. But she was ignoring him, too, because she did not like being scolded and was blaming him for what had happened. But he knew that she would not stay mad at him for long so he said, "What is that thing?"

After a long silence she said, "It's a bird."

"But what's it doing?" he said. "There isn't anything holding it up. Is it in a Center, in free fall?"

"Can't you hear the words?" said Wana crossly. "It's flying, holding itself up by pushing down against the air with its wings, those broad arms with the fuzzy edges."

He could hear words better, he had learned over the years, than could any other member of the family. It was more difficult if they were whispered behind doors or a dividing wall, but he was still able to hear every word they said. He had not told them about his ability because he was afraid it would make the boys like him even less if he was better at anything than they were. Wana was different. She was nice and she liked him, most of the time.

"I can hear but I don't understand

all the words. What is an angle of incidence and a coefficient of—"

"I don't understand those words, either," she broke in. "It's just a bird, flying up in the air and away from the ground."

She still seemed to be angry with him and that made him feel bad. Maybe he should try to make her laugh.

Very carefully he climbed up to stand balanced on the chair, which was soft and unsteady under his feet, and began to flap his arms up and down faster and faster. Wana looked up at him, smiling, until one of his feet slipped over the edge of the cushion and he fell onto the floor.

"I tried very hard," he said, "but I didn't fly into the air."

"We're playing a difficult game here that needs a lot of concentration," said Danal. He gave a nasty laugh and went on, "And you didn't rise in the air because your hands aren't wide enough. Sit down and stop fooling around."

"Did you hurt yourself?" said Wana, being friends again. "You can play this game with me if you like. I'll show you what keys to press to change the pictures."

He wanted to play the game, and push the tiny, close-together buttons that would change the pictures or make parts of them bigger or cause them to stop moving. But if he was clumsy, and he was always clumsy, he might break off one of the tiny control keys and ruin the game and she would not like him again.

He rubbed the wetness from his eyes and said, "No, I'll just watch you,

and behave myself."

"Oh, that's good," said Wana, and laughed.

Unlike the other two, she was too young and nice to hide the relief she was feeling or say things that meant something else.

She changed the pictures to show other kinds of birds and fish and animals, and some of them looked like their parents with no clothes on, but they always came back to the first big, beautiful bird with the slow-moving arms. They were watching it yet again when their mother came in.

"Everyone is being very quiet," she said, "Has somebody broken something or done something naughty that you don't want to tell me about? Or are you all enjoying your games too much to want to go up to the Center?"

Everybody said "No" so quickly that he could not tell who said it first.

His mother smiled and said, "Then let's go. Everyone, zip up your coveralls and make sure your shoes won't come off. I'll carry the picnic. Danal and Cawn, lead the way. Wana next and you . . ." she bent down to check his feet, ". . . had better stay close to me."

"They're all right," he said. "I can tie the laces myself now."

"Good boy," she said, patting him on the head. "Now hold onto my hand and come along."

They left the house and followed the others along the corridor outside, and began climbing the ramps and ladders leading up to the Center. The higher they climbed the easier it became, but slower because his feet

would barely stay on the ground and he had to hold onto his mother's hand or the netting that was stretched tightly along the walls to keep from floating away. The others were moving far ahead of them, shouting with excitement as they pulled themselves faster along the netting, but his mother held him back and told him to be patient. By the time they emerged into the Center, Danal and Cawn were already drifting into the big, empty middle and Wana was making a slow, careful jump to follow them.

Apart from the small pictures of big places shown on learning games, this was the biggest empty place he had ever seen. It would have taken about fifty adults with their arms held out sideways and holding onto each other's hands to stretch from any one side of the hollow space to the side opposite. The last time he had been here his father had told him very slowly that it was the station's cargo bay, that the extending arms of the handling equipment were folded flat against the inner walls and all the sharp edges protected by raised safety nets, padding or sheets of packing when not in use, and that the circular red and yellow door he could see behind the netting was opened only when there was a ship in dock discharging stores or people. His father had stopped trying to explain when it became clear that he had not understood what was being said. But he remembered the words, and now he was older and knew what most of them meant.

Neither had he any trouble understanding the meaning of his mother's

words even when he was pretending not to hear some of them.

"Be careful," she was saying, "and stay close to the netting. Pull yourself along it with your hands, but slowly so you won't drift away. If you get into trouble, shout and I'll come for you. Don't jump too hard because you're very strong and if you hit something when you are moving too fast, you will be hurt. Another reason why I don't want you to jump into the middle with the others is that if you started spinning there would be nothing to hold onto to stop yourself and you would be dizzy and frightened. . . ."

She was still warning him to be careful as he began pulling himself along the net and stopping every few minutes to let his legs swing backwards and up to point toward the middle where the others were floating and turning slow somersaults. Sometimes he stopped himself with just one hand although it was harder to hold steady that way. His mother had stopped worrying out loud about him so he decided to try something new.

If he was forbidden to jump up to the middle like the others, maybe he could try jumping from the padded side of a cabinet to another one nearby and stay close to the netting on the way over, like his mother had told him to do.

The first few times he tried it the netting kept sloping up to meet him before he reached the other cabinet, until he remembered that the Center was a hollow sphere with curving sides and he should aim higher. He looked all around and discovered that

his mother was almost hidden from sight by a projecting cabinet, and anyway, all of her attention was on the others who were shouting at her to watch them. He watched, too.

They were drawing up their legs and folding their arms tightly around their knees, and for some reason this made them spin faster. When he tried to do the same behind the shelter of the cabinet, he could not roll himself up as tightly as they could but it worked anyway. It was great fun even though it made him dizzy. He went back to trying to jump between cabinets.

He must still have been dizzy from the spinning, because as soon as he jumped he knew that he had pushed too hard with his feet and that his aim had been bad. He was going to pass right over the thing instead of landing low down on its side. He was high enough for his mother to see him, but she was still watching the others.

He grabbed at the padded upper edge of the cabinet as it floated past below him, but could not hold onto it, and all that happened was that he started himself turning end over end again. The netting was farther below him than it had been during the earlier jumps he had tried, and he was traveling farther across it before it began curving up to meet him. But then he saw that instead of landing on the netting he was going to come down on a flat, white box that was projecting above it.

He hit the top and one side with his feet, the impact making the box explode slowly into flat, white fragments. He saw then that it was made

from thick layers of light, stiff plastic, bigger sheets of the same stuff that was used as packing for the other children's games. The sheets had been held together with strips of white tape to cover a panel that had a vision screen and colored buttons on it. Most of the plastic sheets were being held together by the tape but a few of them had been knocked loose and were drifting away.

His mother chose that moment to look in his direction again.

"I told you to play close to me," she called, "What are you doing?"

"N-Nothing," he said loudly.

"Wana," she went on. "Be a good girl and jump over there and see what he's doing, then bring him back here. It's time for the picnic."

The loosened sheets of white plastic were drifting away from the vision screen. He would have to replace them before Wana arrived because she might ask questions about them loudly enough for their mother to overhear and begin scolding him. He grabbed the edge of the nearest sheet in both hands and brought it down quickly toward the screen, but something funny happened. The plastic sheet seemed to be pushing against something invisible that could only be the air. The pressure rolled him backward slowly until he bounced into the netting and had to grab it with one hand to keep from floating away. Laughing, and with all thought of tidying up the area leaving his mind, he tried it again.

This time he slid one foot under the net and pressed the sole of the other one down on top of it so that a thick

strand was held between them to keep him from drifting away, then he began flapping his sheet up and down. He discovered that whenever he moved the sheet downward in front of him he was pushed backwards and he could feel his lower foot pulling against the netting, and when he lifted it upward his upper foot was pressed gently against the netting instead of trying to leave it. Feeling confused, he looked at his brothers playing above him and the memory of Danal's words to him when he had been flapping his arms up and down like the big bird came back to him.

You can't fly, he had said, because your hands aren't wide enough.

But if he tried it with a sheet of plastic in each hand he felt sure that they would be plenty wide enough.

"What are you doing?" said Wana, who had arrived unnoticed behind him.

"Shush, don't let mother hear you," he said without looking around at her. "I'm trying to fly like a bird, but it isn't working right."

"Birds are supposed to fly straight," she said in a very loud whisper, "not go up and down like that. Can I play, too?"

"Yes," he said. "The bits of plastic are over there. But what am I doing wrong?"

When he tried to fly straight and level, pushing down with the plastic wings the way the big bird in the education game had done, it made his head and shoulders come up while his legs stayed where they were; and when he lifted the wings, that made him nose-dive into the netting. He

tried to fly straight upward by putting his wings together above his head and sweeping them outward and down to the sides of his knees. That caused him to rise quickly but when he swept his wings up again he moved back against the net again.

Then by accident, but mostly because he was losing patience with the whole stupid business, he twisted his wrists sideways during the up-sweep and found that he kept on moving upward. He tried other things, and found that when he stretched the wings out flat from his sides without flapping them, he slowed almost to a stop. Holding only one wing steady when he was moving made him turn slowly in that direction.

"Wana, look!" he said, forgetting to whisper in his excitement. "When you push down against the air you go up, and if you turn the sheets sideways so they slide through the air edge-on, you don't move back at all and you're ready for another push down. . . ."

"Like this?" said Wana, who had been watching him closely. She laughed and called, "Danal, Cawn. Look, I'm flying like a bird. Wheeee!"

The two big sheets of plastic were making her tiny body look even smaller, and the quick, excited movements of her shorter arms were pushing her along faster than he was able to go. In her eagerness she was sometimes forgetting to turn the sheets completely edge-on during the up-sweeps so that she was wobbling all over the place, but already she was nearly halfway up to where the boys were playing.

"Yes," he said. "But don't move your arms so fast. You look like the pictures of the little fat birds. Try to fly like the big, slow one.

"Like this," he added, flying after her.

His mother began scolding him as soon as she saw them moving away from the netting, but by that time Danal and Cawn were shouting questions at Wana and himself so loudly that he was able to pretend not to hear her. The boys wanted to know where they had found the plastic sheets and how they were able to fly like that? Wana reached them first, but flew helplessly past and fluttered all over the place as she tried to slow down and go back to them. He watched her for a moment, trying to understand the things she was doing wrong, then he used his wings to raise his head and chest so that his legs swung around until he was moving backward. When he started flying in the new direction it surprised him how easy it was to slow to a stop close to where the boys were hanging motionless and watching him without speaking.

"That, that was *neat*. . . ." Danal began. But the few minutes of silence had allowed their mother's voice to be heard and they had no excuse for ignoring her.

"Mom, there's no problem," Danal went on. "He won't hurt himself, or us. Honestly, he's doing just fine. Cawn, grab my other hand and bend your knees until your feet are flat against mine, then let go and push hard. We have to get back to the net and get some wings of our own. . . ."

"Wait," he said, hoping that he wasn't going to do something stupid again. "It would take a longer time for both of you to get down to the net and crawl over to the plastic sheets. Maybe, maybe if you held onto my legs I could fly you down faster."

"Right," said Danal without hesitation. "Cawn, grab his other leg."

He felt his body begin a slow, twisting spin as their hard fingers tightened in a double grip around his ankles and he was afraid that he would not be able to control himself. But when he started flying again, sweeping the wings from high above his head and sideways to his knees, the weight of the boys dragging behind seemed to stabilize him. By spilling the air from one wing or the other, he was able to turn until he was heading toward the area of netting containing the plastic sheets.

"That's very good," said Danal.

"No it isn't," said Cawn. "We're not moving."

"We're moving, but slowly," said Danal. In the show-offy words he used when he was trying to sound grown-up like their father, he went on, "He has the inertia of three bodies instead of one to overcome. Watch the way he twists his wrists before the up-sweep, and remember how he does it. We're moving faster now. . . ."

They let go of his legs just before he reached the netting, and within a few minutes they had wings, too. At first they were very clumsy, flying into the netting or projecting cabinets while they laughed and shouted at each other. But very soon they were flying close to the netting without touching

it, and playing follow-my-leader around and over the padded equipment. Their mother had stopped calling to them to come back for their picnic, but that was because they were making too much noise to hear her and having too much fun to want to stop for anything as boring as food. He thought that she might be angry and would scold them when they got home, but when he looked across at her she was smiling.

"Let's try to do something difficult," said Danal, using his adult's voice again, "like flying close together in line abreast formation right across the Center. Theoretically, in the weightless condition, the wings should enable us to control movement in three dimensions, right? So line up on the net, let go at the same time, and fly."

On the first attempt their line was anything but straight, mostly because Wana got excited and flew too far ahead of everyone else. The second and third attempts were better although their line was still a bit crooked. During the fourth attempt when they were holding a tight, neat formation and moving toward the middle, Cawn kicked his right wing, breaking the sheet of plastic in two. With only a wing and a half to fly on, he kept turning sideways even when he tried to move the half wing twice as fast as the good one.

Cawn turned away quickly and flew down to the net, returning a few minutes later with another sheet of plastic held between his knees.

"I'm sorry," he said, handing him the new wing. "It was an accident."

It was the first time that Cawn had

said anything to him that had not had words like "Big" or "Stupid" in it somewhere.

"Right," said Danal, flying closer and looking straight at him. "I've been thinking. Flying in formation isn't very hard to do. We should do something with our wings that is fun but more difficult, don't you think?"

Before he could reply, Wana shouted, "Oh, yes," and Cawn said "Like what?"

The game they devised wasn't all his idea because Danal and Cawn and even Wana suggested changes that made it more complicated and much more fun. They played it right in the middle of the Center, flying around and over and under each other as close as they could without touching—like a slow, ungainly swarm of giant insects. Their mother had stopped telling them to be careful and was just watching and smiling up at them. They had all become very good at the game, there were no more collisions or broken wings, and even though it was exciting and hard work he was having fun, much more fun than he could have believed possible. That was because the others were not treating him like he was stupid anymore. But it was a quiet game because they were all concentrating so hard on what they were doing that there was no time to waste on shouting or even laughing.

Their busy silence was broken by the voice of his father who had joined his mother on the net.

"Weightless flying," he said quietly. "Whose bright idea was that?"

"When I tell you," his mother replied,

"you won't believe me."

"You mean . . . him?"

"Yes," she said, "the un-birthday boy."

His father was silent for so long that he felt sure that he was going to be scolded, but instead said, "They're very good at it, especially him. But let's face it, even with the best will in the world we never were qualified to handle this kind of situation. He is not a normal child."

"No," said his mother.

"Do you think this sudden aptitude for weightless maneuvering," his father went on very quietly, "means that he's beginning to mature mentally as well as physically, or is that just wishful thinking on my part? It's a pity we won't get the chance to find out."

"Why not?" said his mother sharply. "What are you talking about?"

"Keep your voice down," he whispered, "I don't want him to hear us, at least not until we decide how and what to tell him. We notified the child care authorities when we found him, remember, but in the circumstances I wasn't sure if they would be able to do anything about him. They have. He'll be leaving us very soon."

"Children," he went on, raising his voice, "I'm sorry for cutting short your fun, but you'll have to come home right away. There is a ship expected soon, an unscheduled visitor, and the Center must be readied for its arrival. But don't worry, I'll make sure there are more plastic wings available the next time you play here. Quickly, please."

The others were protesting loudly, but he kept quiet because he was re-

membering the things his father had been saying about him that he was not supposed to overhear, and wondering what they meant. Suddenly the nice, warm feeling of belonging that he had felt since the flying game had started was leaving him, and he was feeling afraid.

They were returning to the net, and showing off by flying in the tightest formation they had ever tried, when he said, "Danal, can I fly with you like this next time? This is the best birthday there has ever been. Thank you."

Cawn laughed. "But it isn't even your birthday."

"Stop teasing him, Cawn," said Danal. Keeping one eye on his place in the formation he went on, "It isn't your birthday, so far as we know, because nobody here knows when you were born. We don't even know your name, but after today we'll have to stop calling you stupid. You found the plastic sheets and were smart enough to see how we could fly with them. If we had found them we would probably have done the same, but you did it first, and as a result we had more fun than we ever have before. So don't worry, we will not fly again without our instructor. It is we who should thank you.

"If you want to," he went on, "you can make this your birthday, too, and from now on we'll have parties on the same day. Why are your eyes wet?"

"I don't know," he said.

By the time they reached their waiting parents, there were adults crawling all over the Center, removing the padding from the machines and de-

taching and stowing the netting. His parents said that they could have their picnic at home, and after that they did not speak, which was not the way they usually behaved on a birthday. He had no interest in the picnic because, no matter what the others got, he would be given the usual soft, tasteless mush. On other birthdays this made him angry, but today they all told him that he could play with their games if he was very careful. He had just finished a long, complicated game without either winning or breaking anything when he heard the distant sound of the docking siren. His father left quickly and his mother sat down beside him. She put a thin hand on the back of his neck.

"Please," he said, "I don't want to leave you. I like it here, now."

She began pushing her fingers through his hair, the way he liked her to do, without speaking.

"I—I know you don't like me," he said, "because I'm big and stupid and sometimes I break things and make you angry. And because you don't give me nice food to eat and father does nasty things when I am alone in my room—"

"But he had to do those things to you," she broke in, "to find out why ordinary food made you sick and the reasons for the other things wrong with you. We explained it to you, but you didn't understand. He didn't mean to hurt you, or risk frightening the other children.

"Don't worry," she went on, tightening her fingers in his hair and shaking his head gently, "he will never do those things to you again."

"It's all right," he said quickly. "He can do it again if he wants to. The food you give me is all right, too, and I don't mind getting other people's old presents. But I'm not as stupid and clumsy as I was, you saw me flying in the Center and, and I'll try to be better and not break things and speak my words properly and—"

Suddenly he turned and wrapped his arms so tightly around her that she moaned and her breath puffed into his face. He had forgotten that he was not supposed to hug the other members of the family like that.

"I'm sorry," he said, letting his arms fall loose again. "It's just that today was nice, the nicest day I ever had. Even Danal and Cawn like me now and, and I'm getting smarter. Please, I don't want to be sent away."

The others had stopped eating and playing their games to look at their mother. Danal said, "Why should he be sent away?"

When she replied she was looking only at him but seemed to be answering everybody.

"I'm sorry," she said, "but you don't belong here. You already know or suspect some of this, because sometimes the boys say things they shouldn't. But this may be the last chance I have to tell you how you came to be here and why you have to go away. I believe that you have become intelligent enough to understand what I'm saying."

He had been found as a very young infant who was close to death in a survival pod that was thought to have come from a small ship which had detonated nearby, scattering its wreckage so finely that they had been unable to

discover anything about the number or identity of the occupants. The incident had been reported to the child care authorities on the home world, but that was very far away and the response time was expected to be in proportion to the distance. As a temporary measure, because of his father's profession plus the fact that they were the only couple with children on the station, they had offered themselves as temporary foster-parents.

They had not thought that the period would be a lengthy one because everyone had expected him to die.

"But you didn't die," she went on, "although many times we thought you would. Especially when the nice, ordinary food we tried to give you brought out a rash on your entire body, or raised your temperature or made you throw up or dirty your bed. You kept growing bigger but not much smarter and you couldn't talk right and you broke things all the time. We didn't know what was wrong with you, and when your father tried to find out, you cried and I made him stop it. The stuff we give you now doesn't taste nice, but it is specially prepared so as not to make you sick. We hadn't the proper facilities for treating you here and our authorities, who would know better what to do, have been very slow to respond so that we became the only family you had.

"We tried to treat you and love you as one of the family," she went on, placing her other thin, boney arm tightly around him, "we really did. Your father and I, I mean your foster-father and I, came to like you a lot,

and we will miss you. But now we have to pass you on to people who will know how to treat you properly. You have never been happy here and—”

“But I’m happy now—” he began, when the voice of his father on the communicator made him break off.

“We’re ready for the handover,” he said over the sound of many other voices talking loudly in the background. “Quickly, dear, bring him to the rec room. Bring everyone to the rec room.”

That was a room big enough to hold everyone on the station, his mother had once told him, which was fitted with machines and games that exercised the body as well as the mind. She had laughed and added that only grown-ups were allowed to go there because the adults drank things that were not suitable for children. Now he would be able to see it but he didn’t want to go.

“No!” his mother replied in a voice even louder than his father’s. “It’s been hard enough trying to say good-bye to him here. Having to do it all again in public wouldn’t be fair to him or the other children, or me. Give us a few more minutes together, then I’ll bring him to you.”

“You don’t understand, dear,” said his father. “Bring everybody. You’ll all want to see this. They sent another doctor to look after him. But it wasn’t our child care authorities who sent her, it was *theirs*!”

He was afraid, and on the way he hung back for as long as possible until his mother pushed him through the recreation room door. But when he

saw the figure standing in a clear area of floor beside a table that barely came up to her knees, something so strange and wonderful happened in his mind that he could hardly breathe.

She was big and thick and so tall that her head almost touched the room’s high ceiling. Her legs and arms and body bulged out so much that they made her white coveralls look tight, and there were two big, soft bulges on the front of her chest. She had a big head, too, and hair like his except that it was black with gray streaks in it. Without knowing why, he let go of his mother’s hand and ran to her. She knelt down quickly so that he ran straight into her open arms.

They squeezed him so tightly that he could hardly breathe. But they were big, soft arms, not like his mother’s thin, hard ones, so they didn’t hurt him. Her eyes were like his, too, because they were beginning to get wet.

She pushed the soft, pink edges of her mouth against his forehead for a moment, which was the first time anyone had done that to him, then gently moved his arms from around her neck and stood up. Looking at the people crowding the room, she began to speak nonsense words. But there was a box on the table beside her which repeated them so that he knew what she was saying even though he didn’t understand all the words.

“Based on the elapsed time since the accident to their survey vessel,” she said, “plus the genetic information available to us on his parents’ medical files, which dictates the hair and eye coloring and other inherited physical characteristics, I have no

doubt that this is their son. Because of the vast distances involved between the accident site and our respective home worlds, the bureaucratic delays, the general disbelief on both sides that it was possible for him to survive for so long, a very long time passed before we learned about the survivor or your people would allow us to do anything about him. Regrettably, the greater share of the blame is ours because, instinctively, and we now realize mistakenly, our two cultures disliked and distrusted each other and deliberately avoided making the contact in depth that would have reduced our growing hostility. But this incident, the way you have cared for this child as one of your own, will end what could have become a very dangerous situation.

"The major responsibility for that," she went on, looking only at his father, "lies with you, Doctor, and your family. With minimum physiological information and a subject who was too young to be able to speak or help himself, not only did you devise the food regimen that enabled him to survive in good health, your family adopted him, cared for and brought him up as one of your own. Fostering such a child must have posed extreme difficulties for everyone concerned, and if the positions had been reversed I do not believe that I could have coped with them, but I am sure that my later physical examination will only confirm the fact that you have raised a strong and healthy seven-year-old Earth-human boy. My sincere pro-

fessional and personal compliments to all of you.

"Now that we are beginning to learn more about your culture," she continued, "including the deep significance you place on a person's birthdate and correct personal identification, I can tell you that his name is Thomas Carmichael although, because of his youth, we would call him Tommy. . . ."

"Tomee," said Wana, leaning back onto her tail to look up at her, "is a nice name."

Cawn said, "And now he has a birthday, too."

"Now," said Danal, "he has two birthdays."

She smiled down at them and went on, "Now that they know you have kept him alive, he has many relatives who are anxious to have him home as soon as possible. . . ."

He heard but did not listen to the other things everyone was saying because he was hugging and saying good-bye to the only family he had ever known. He was careful not to squeeze their thin, shiny bodies too hard, and he was especially gentle with little Wana who had always been his best friend. Without knowing why he did what the giant, gray-haired woman had done to him, he pushed his mouth against the top of her tiny, round head just between the eyes.

Her eyes were not like his because they opened and closed from the sides and they didn't get wet, but he had the feeling that she wished they could. ■



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ELECTRONIC REPRODUCTION PROHIBITED

Grey Rollins
**WHEN THERE'S
A WILL, THERE'S
A WAY**

*Wherein new meaning comes to the phrase
"Living Will," among other things. . . .*

Illustration by Steve Cavallo

Talk about America's love affair with cars. . . .

I used to be human. Now my mind resides on a NeVPROM chip under the hood of an Icarus—one of the sleekest, fastest, sexiest cars on the road.

I arrived at the dealership in late February, and spent four days out on the lot getting dusty before I was able to talk one of the salesmen into getting me polished up and put on the showroom floor where it's nice and clean.

She came in three days later. Within seconds, I had spun all my eyes towards her.

Why am I still interested if I don't have a you-know-what? Call it force of habit. Call it esthetic appreciation for the finer things in life. Call it what you like, but I still enjoy looking at women.

She was coming at me like she already owned me. A purposeful walk, heels tapping a steady beat on the tiles. She stopped about five paces away and cocked her head, studying my lines.

"I come equipped with top-of-the-line De Armond seats," I told her. "Fourteen individual, leather-covered, pneumatic cushions that contour to fit your body like a fine glove."

"The way you say it, that almost sounds suggestive."

"Live a little." I popped the door latch and gently swung the door open with my C-4 hydraulic extensor. "Get in," I invited.

She hesitated, then slid behind the wheel.

Roger Tarker, one of the salesmen, arrived on the scene. He's big, obnoxiously handsome, suave, and ultimately as shallow as an ashtray. "Ma'am, you

and that Icarus were made for each other. You look good in it."

She turned and looked him over with a neutral expression. "My name's not Ma'am," she said evenly, "it's Alexis. But you can call me Mrs. Hanson."

I took the hint and slammed the door in his face. Now we were alone.

I spoke quickly. "The sticker says sixty-two-five, but they'll take fifty-six if you push; the model hasn't been moving well."

"Why are you telling me this?"

"Because I want you to want me."

Her eyes narrowed.

I had that sickening elevator-drop sensation. I'd been presumptuous.

But then she nodded ever so slightly. "Fifty-six," she said softly.

"Get out and kick my tires. Find a body panel that doesn't fit just right. I've got to open up before they decide I've gone renegade and pull my module." I opened the door, neatly clipping Roger's thigh with the edge as it swung past.

"Please give the lady room to get out, Mr. Tarker," I said politely.

The look he gave me was decidedly strange, but he let it ride. He thought his attention, both professionally and personally, might be better focused on the woman standing before him.

"Show me the engine," she commanded Roger.

He blinked. After all, even in this day and age, few women are interested in the mechanical portions of an automobile, especially those who come in dressed, as she was, in an elegant suit that must have cost upwards of five hundred. But he rallied nicely and leaned past her to trip the manual re-

lease to the hood. I beat him to it.

"Opening the engine compartment, Mrs. Hanson."

The corner of her mouth twitched as though she was trying hard not to smile. "*You* can call me Alexis," she said, glancing my way.

She listened attentively to Roger's canned sales spiel about my vital parts. I tactfully kept quiet. It's not polite to sing one's own praises—better to let others do it for you.

"Where's the personality module?" she asked.

Roger leaned deeper into my engine compartment. "Here," he said, fingering the reinforced box that protects my NeVPROM. "Flip the catches . . . so . . . and . . . so, and the top comes off. There are four chips in here, but the personality module is the big one on the left."

Alexis leaned into the engine compartment, squinting at my chip. She was whispering numbers under her breath. ". . . Nine, six, six, three. You're mine, fella."

It sounded like my serial number.

Roger smiled smugly behind her, not having heard her whisper. "They're easy to replace if you don't care for the personality that comes with the car."

"Oh, I don't think that will be necessary," Alexis said calmly as she withdrew. "A man with no spunk isn't worth having around. I can't imagine a car like this," her fingertips brushed my fender lightly, "with the personality of an accountant. Something like an Icarus needs to be a bit of a rogue. Anything else would be a waste."

Roger forced a smile to his face. "Of course."

She sighed. "But the car *is* expensive."

They went into his office to dicker. I don't think he took her entirely seriously until she began to count out one thousand dollar bills on his desk. Money talks, but cash screams, and he was being deafened.

She finished counting and looked at him. "Well? Do you want to sell me that Icarus?" She pointed out the open office door towards me.

"But Alexis, that's only fifty-six thousand," he said hoarsely. His eyes never left the bills.

"That's correct. I have no intention of paying full list price—and my name is Mrs. Hanson."

He nodded, chastened. "Uh . . . yes, Mrs. Hanson. Excuse me, I'll need to talk to the sales manager."

After he left, she turned and gave me a slow wink. There was a half-smile on her face. I made sure no one was looking, then opened the driver's door, ever so quietly. Only an inch, but the invitation was unmistakable. She discreetly gestured for me to close it, then composed herself.

Roger returned with the sales manager. Unfortunately, they closed the door, so I had no way of hearing what was said, but when the door opened again, Alexis was smiling.

Since it was our first time, Alexis drove. Once I knew where she lived, I'd be able to do it on my own.

Oh, sure . . . she could have told me the address, I could have looked it up in my internal maps, queried the Global Positioning System, and driven her there myself, but that would have tak-

en all the romance out of it. Besides, there would be all the time in the world for me to drive her—let her have this one symbolic trip.

"How do you feel?" she asked.

"I'm glad you bought me."

"You mean, me, specifically?"

"Of course."

A thoughtful pause. "Why me?"

"You're beautiful, classy, and intelligent. If I were still a flesh and blood man, I'd be doing my damndest to invite you to dinner."

She laughed gently. "So what kind of man were you?"

"I don't know."

"What?"

"When they transfer people to chips, they pare away the memories. It wouldn't do for me to suddenly make an unplanned right turn, just to see if my old high school is still there. It's part of the price you pay for a second lease on life."

She sounded subdued. "So you remember nothing at all about being human? No favorite foods, no birthdays, no . . . loved ones?"

"I'm afraid not."

"I'd heard that, but I didn't believe it. You still seem like a whole person. Isn't your personality formed from your experiences in life? How can you still have a personality if your memories have been stripped away?"

"Anything that's a distinct part of your personality may have started in response to a particular event, but it becomes habitual. Your personality can survive being deprived of the memories that gave birth to it."

"Sounds as though your personality is frozen—almost fossilized."

"No, I'm free to grow again, to acquire new memories, develop new traits. At least until this car gets scrapped. Then I'll start over again."

"Oh, no you don't!" she snapped.

"I've already lost you once, and I don't intend to lose you again."

"Alexis, I don't—"

"You were my husband, and God help me, I still love you."

As far as Alexis was concerned, I was simply suffering from amnesia. That's not to say that she thought I could be cured; she wasted no time on futile efforts to try to help me remember things that were forever beyond my grasp. Her plan was to create a rich bed of new memories that would serve as a foundation for another phase of our relationship.

Money would not be a problem for a while. The payoff from my life insurance had left her well-off. Even after buying me, it would be quite some time before we would have to worry about practicalities.

Once I understood that Alexis had gone to enormous trouble and expense to track me down, it no longer surprised me that she had turned into the parking lot of a motel not far from the dealership. An hour after buying me, Alexis filled my trunk with her luggage.

I opened the door for her. "Are we going home?"

She slid in and folded her hands neatly in her lap. "No, we're going on a trip."

"Where do you want to go?"

She grinned. "You decide."

This, I'm afraid, took several seconds

for me to process. "Alexis, that's the very thing I'm *not* supposed to do. I'm the car. You're the driver. You're supposed to tell me where *you* want to go, not the other way around."

She frowned. "You mean you can't? They took that away from you, too?"

"There are lots of things I can't do anymore. I can't vote, can't dance, can't—"

"But, it's OK. I give you permission."

"Alexis, I *can't*."

"Damn you, you were a man once, be one again!"

And to my utter astonishment, she was crying.

"Alexis," I said softly.

"Yes?" she whispered.

"It isn't legal, but something can be done."

Whether I had known anything about electronics when I was human was a moot point. Now that I had been placed in an automobile, I had full schematics of my internal circuitry available to me as part of my diagnostics capability. I was about to use that information to induce a failure.

The NeVPROM next to me on the circuit board was my supervisor chip, the silicon conscience that kept me from going astray. Pin fourteen—the numbering system gave Alexis some problems until she figured out that pin one was to the *left* of the notch and that the pins were numbered counter-clockwise looking from the top—was the reprogram pin. Induce a voltage on pin fourteen and a NeVPROM promptly forgets its programming.

Bright early summer Sun, a light breeze, a motel parking lot, and a determined woman with a screwdriver

and a bent paper clip.

Alexis opened the casing, undid the screws that held the circuit board down, and turned it over in her hand. Counting carefully, she located pin fourteen, used the paper clip to bridge from it to the bus where power entered the board, but stopped just before making contact.

"You promise this won't electrocute me?"

"Absolutely solemn promise. It's only three volts more than the nine volt batteries that go in radios."

"That's something you used to say."

"What?"

"Absolutely solemn promise. Are you *sure* you're not hiding in there?"

"I'm sure."

She made contact.

And it nearly killed me.

I hadn't anticipated the backlash that hurled through the car's computer system. I hadn't known I could feel pain, but I got educated in a hurry.

It took several reset cycles and a few seconds of real time before I could catch my breath. Tentatively, I reached out. The supervisor chip was devoid of programming. Effectively dead. Everything would be up to me from now on.

I started the engine as soon as she got back in.

"Where are we going?" she asked.

I chuckled. "I'm taking you out to eat, of course."

Ten minutes later, she burst out laughing as I pulled into a drive-in restaurant on the way out of town—the only way we could be together as she ate.

Twenty minutes outside of Atlanta,

headed east on I-20. I was driving. Alexis had slid herself around to the point where she was effectively sitting side-saddle across the front bucket seats. Her skirt had caught on the edge of the seat when she turned and was pushed up past the top of her stockings. Her garters were deep purple.

I was admiring the view from two vantages, the dash and the smaller eye in the interior rearview mirror.

"Tell me something," she said. "Are you ever curious about your previous life?"

I wished I could shrug. "Like the man says, 'I am what I am.'"

"You didn't answer my question."

I affected a sigh. "Of course, I am. But why bother? I can't go back. Obviously, I was near death, either due to accident or disease. My Living Will kicked in and my personality was read onto a chip before my body died. By the luck of the draw, that chip ended up in this car. I feel pretty fortunate to be an Icarus. It has a nice body."

She laughed. "As it happens, I like your body, too. But don't you wish sometimes that you had a human body?"

I paused, then said seriously, "Alexis, you'd better be glad I don't."

Her eyebrow raised. "And why is that?"

"Because if I had a human body, you'd have been screaming rape over every inch of the last fifteen miles. I've been looking at your legs ever since you turned sideways. At this particular moment, I'm thinking some very personal, very physical thoughts."

She didn't blush, didn't flinch. "You like what you see?" she asked.

"Alexis, men turn to watch when you pass. They breathe your scent and strain to hear your voice. Every single one of them would kill to spend an hour alone with you. I'm no less interested, I just can't shower you with flowers or buy you dinner."

She gave me a sultry smile. "You took me out to eat."

"And if there were still such things as drive-in movies, we could see all the latest films, but I have yet to figure out a way to get you into bed. Trust me, it's not for lack of trying."

"So . . . if I could somehow smuggle you into a hotel room . . . what could we do?"

In spite of the preposterous nature of the conversation, she sounded serious. I thought about it for a second, then gently fluttered the number eight pneumatic side cushion of the driver's seat where her upper thighs rested on the soft, supple leather.

Her eyes widened for a second, then she resettled herself a bit lower in the seat, twisting slightly to her side. "Try that again." After almost a minute, and some fine tuning of her position, she said distractedly, "Um, is there, ah, something I can be doing for you?"

"Just let me watch. I'm a voyeur these days."

We drove to Washington, D.C., then up through Vermont to Maine for a week. Back roads were our preferred mode of travel. They were slower, curvier, and more fun to drive than the interstates. More than once Alexis slept in me when it got late and we weren't sure where to find a motel out in the country. My internal maps aren't

that detailed.

For some reason we both got a kick out of crossing bridges. Quite by accident, we found an old covered bridge, said to be one of the last in existence. The scene was perfect. Trees grew densely up the slope on the far side and a field was behind us, towards the setting Sun. I pulled over onto the bank of the stream before crossing.

"Why are you stopping?" she asked.

I permitted myself a chuckle. "For the romance of it."

She took a long look around us at the pastoral setting. There was not another soul in sight. "It *is* beautiful," she admitted.

"You know that pack of crackers you keep in the glove box? Get them out. Let's have a picnic."

"What do I drink?"

"I've checked the maps. There's nothing significant between us and the headwaters of this stream. The water should be safe to drink."

She gazed at my eye in the dash for a long time before responding. "You know, you're right. You haven't changed. This is just the kind of thing that you used to do."

"Romance isn't flowers, it isn't going for walks, and it isn't sex. It's a sense of anticipation. I may not be able to hold you in my arms and kiss you, but I intend to romance you within an inch of your life."

She leaned over and got the crackers out of the glove box, then looked at me with misty eyes. "I love you," she said quietly.

"Alexis—"

She held up a hand to stop me. "Don't say anything. I don't even know

if you *can* love in your present form. I think we're on uncharted ground, here. But that won't stop me from telling you how I feel."

I opened the doors and she kicked off her shoes and rubbed her toes in the grass as we watched the Sun quietly slip into evening.

You can't spend all of your time in a car, and you can't always find a drive-in restaurant when you need one, so we detoured into Boston and had me fitted with short-range transmitters like they use on microphones. That way I could talk to Alexis wherever she happened to be. It worked out so well that she splurged and bought a wider bandwidth transmitter and a portable eye. Now I could see as well as hear. She bought a cheap sky-blue day pack and put the equipment in it, then carried me slung over her shoulder wherever she went.

Strange looks came with the territory. She would set the bag on the table in a diner and proceed to talk to it earnestly. Waitresses adjusted quickly enough, once they saw that the bag was full of gadgetry, but those who weren't close enough to see inside the bag invariably seemed to form the impression that Alexis had a mental problem of some severity. Once she was asked to leave by a manager who had been approached by some nervous patrons. Fortunately, these problems were quickly straightened out.

We were working our way south along the spine of the Appalachians on the Skyline Drive. Night had fallen and Alexis was driving, just to keep in practice. Mountain roads at night, unfamiliar

iar ones, can be tricky. Curves seem to come out of nowhere, often more tightly radiused than you expected—especially if you're in an Icarus going at a fair clip. She was doing well. Only a slight tightness around the eyes betraying her concentration as her hands chased each other around the perimeter of the wheel.

A sign came up, then whipped past. "Did that say what I thought it said?" she asked me.

"There's a lodge ahead. Would you like to stop for the night?"

She thought this over for a few seconds, then backed off the accelerator.

The lodge was a fine old specimen, built back during the Depression. She got a room in the main building, trudged through the darkness and opened the door, then gasped.

"My God! I didn't know they made places like this any more."

"They don't. The Depression was a long time ago."

She gave me a wry look, then began running her fingers lightly over the rich, old chestnut paneling. She stood and admired the fireplace made of stone. "I wonder how much it would cost to stay here the rest of my life."

From my vantage point on the bed, I watched her walk slowly around the room, leaving no single thing untouched. Then she took a deep breath and I could almost see the tension melt away. She began to unbutton her blouse.

"Oh, for want of a pair of arms," I murmured.

She gave me a sidelong look. "Maybe we ought to see how much it would cost to get you a prosthetic or two."

She balled up her stockings and tossed them onto a chair with the rest of her clothing.

"You wouldn't mind rubber arms?"

"You talk a good line, mister. I'm tempted to put you to the test."

After she bathed, she pulled on a soft terry robe and sat on the bed next to me as she brushed out her hair. "Seriously," she said, "supposing there were a way, a practical way, to fit you with arms. Then what?"

"Well, to begin with, I think I'd start by exploring every inch of your body. Granted, being able to look is nice but I want to *touch*."

A lazy smile began. "Oh? And why don't you tell me what you'd like to touch."

As I spoke, her breathing deepened. After a few minutes, she reached and turned out the light, then settled back next to me.

"Talk to me. Tell me more," she whispered.

I heard soft sounds in the darkness as she undid the belt on her robe. "Alexis?"

"Shhh. If you can't touch me, I'll have to, just tell me what you want me to do. . . ."

Slowly, softly, I described in detail what I would do if only I could, guiding her imagination. She, under cover of darkness, used her own hands to bring the fantasy to fruition. Her breathing quickened, caught once, twice, then began to slow.

"That was . . . very nice," she said. "I've never touched myself with a man near me. It always seemed too . . . I don't know. It's just not something women feel comfortable with, I guess."

"So what's the difference?"

"I don't know, really. I . . . don't misunderstand, but you're kind of imaginary to me already. I suppose it was just easier for you to fit into my mind than it would be if you were lying here next to me."

"It almost sounds as though you prefer me like this."

Her tone was reflective, almost sad. "Keep in mind, whether you remember me or not, we've known each other before. I've known you as a man, and as a machine. Given a choice, I'd take you as a man, but we have to play the hand we're dealt." She rolled her head on the pillow and faced me in the dark. "I hope that I haven't hurt you saying that. I don't know what, or even whether, you can feel. I know that from a certain point of view, you're helpless, that you'd have to take whatever I dished out. I don't want to take—"

"Alexis—"

"—Advantage . . . what?"

"I love you."

She cried herself to sleep with her arms circled around me.

In spite of it being mid-summer, the next morning dawned cool and comfortable. There are advantages to being in the mountains.

Small noises came through the window.

"What's that?" Alexis asked sleepily.

"A doe."

"Seriously?"

"She's been eating the grass around the edges of the parking lot. At the moment, she's right outside the window."

"But how . . . oh, that's right, you're

not just in here with me, you're out in the car, too."

Quietly, Alexis slipped out of bed, padded to the window, and stealthily parted the curtain. "Oh, she's beautiful!" she whispered, peering out.

"I've been watching her for a while now. There are three others in sight at the moment. If I had a screen, I could show you what I see. You wouldn't even have to get out of bed."

She let the curtain fall back into place and turned back to me. "Now, why didn't I think of that?" She quickly slipped into the bathroom, brushed her teeth, and within ten minutes, we were packed and ready to go.

As we headed south, the terrain flattened somewhat, then began to steepen again. We stopped at the overlooks to enjoy the view. Occasionally Alexis would get out and stretch her legs, walking the paths, taking me along in the bag, although we were limited by my transmitting range as to how far we could go.

It was late afternoon when we got back from one such jaunt. I popped the door open for her as we approached the car. She leaned across and gently set the bag on the passenger seat, then slid in.

"OK," Alexis said. "Tell me the truth. Just how far can we go towards making you *really* portable? I mean, let's take the chip out of the car and put it in the bag so you don't have to transmit back and forth. You'll need eyes, ears, a screen . . . and, yes, dammit, maybe even arms."

We spent the next twenty miles discussing the practicalities. She didn't understand the differences between

the new lightweight doped-ceramic screens and the older silicon-based ones.

I was saying, "The ceramics have a lower current drain, but they're fragile as hell—"

Up ahead there was a recreation vehicle the size of a small bus. Bumper stickers proclaimed to all and sundry that they had been everywhere and seen everything. They were crawling along slowly—flatlanders driving manually, terrified of the hairpin curves.

There were four cars crowded behind. The second one in line, clearly fed up with the pace, suddenly switched into our lane, sprinting to pass before we pulled even.

He wasn't going to make it.

I hit the brakes.

Alexis looked up from my eye in the dash to the oncoming car, and screamed.

I kept waiting for the supervisor chip to kick in with its override routines to prepare us for the crash.

But the supervisor was disabled. . . .

My first—my only—priority was to protect Alexis. For once, I blessed the speed with which I could calculate. The other car was still accelerating in a doomed attempt to slip ahead of the RV. There was no way I could stop in time, and there was nowhere else I could go. To my right was a sheer drop-off, to my left a solid wall of rock.

With three-quarters of a second remaining, I blew the explosive bolts in the frame so the car would telescope, crushing more easily as we impacted. Half a second left: I triggered the whole-car air bag and lost all forward vision as it billowed suddenly from under the bumper. As we hit, I triggered

the upper and lower driver's air bags.

As the hood buckled, I was hoping I had done it right, I never had a chance to practi—

Phoenix, Arizona. Dry heat and a hazy, glaring white sky.

An economy sedan.

It could have been worse.

I must have signed a Living Will, but I don't remember. My memory chips are new and empty, waiting for a career spent hauling kids to piano lessons.

A taxi pulled up, way across the lot. A woman got out. The wind whipped at the hem of her sundress, pressing the fabric against her legs.

Nice legs. Real nice legs.

The legs started walking—with a slight limp.

The closer she got, the more obvious it became that she was beautiful. A little thin, a little pale, a little worn, but beautiful.

A salesman was closing from behind her. Timothy, I think I heard someone call him the other day.

The woman's eyes were on me. They never wavered, even as she slowed to stand before me, her hair streaming out behind her as the wind tried to toss it into the Sun.

She said, "I don't think you'll remember me, but we know each other."

The salesman caught up with her. "Can I help you, ma'am?" He gestured at a car three down from me; more options. "We've got this nice new Celeste over here on sale. It's got—"

Without turning, she waved him into silence. "No, thanks. I've already found the car I want. . . ." ■

Bud Sparhawk

THE BILL

"Dave's Vehicular Treatment Center—this is billing services," Tonya announced cheerfully. "Please give me your last name and the date of service."

"Uh, it was January 23, 2002, Carroll is the last name. My car had a little problem—a rattling sound. I wanted to make sure that it wasn't something serious and Dave's was the closest service center. I wanted to get an answer as quickly as I could."

"Did you receive cheerful service? Was your car fixed properly?"

"Sure, your people fixed the rattle, but the bill looks too high for just fixing a simple rattle," the man's voice barked angrily. "I don't really understand these charges. There's something on the bill called lift fees and portage—what's portage, anyway?"

"Portage fees are normally charged for transporting your vehicle from reception to the examination site, and, when the procedure is completed, back to the recovery area."

"You mean driving the damn car into the garage and back into the lot? I

have to pay \$500 for some dummy to drive my car one hundred feet and put it on the lift! If I'd known it would cost that much I could have done it myself!"

"I'm afraid that our Center's insurance wouldn't allow you to do that without first signing a waiver of responsibility, sir. Only certified and qualified personnel are allowed to operate vehicles within the facility. Believe me, it is for the protection of all of our clients."

"Damn silly rules, if you ask me," he grouched. "Now what are all of these other things—funnels, gloves, and miscellaneous supplies? What is all of that about? Why do I have to pay for all of those things?"

"We have to charge for miscellaneous Center supplies, such as the funnel and gloves, to recover our loaded costs. Dave's VTC isn't running a charity, you know."

"But aren't these charges a little exorbitant? I could buy a freaking *case* of gloves for this price!"

"I'm afraid that you don't appreciate the economics of our operation,

sir. The insurance companies all insist that we allocate our overhead costs to supplies instead of charging for them separately. I'm a little surprised that your insurance company should have a problem with it."

There was a momentary silence at the other end of the line. "I, uh, don't carry maintenance insurance for my car. I didn't think I could afford the premiums."

"I see," Tonya replied with a barely concealed sniff, wondering if he was just another deadbeat, wanting the government to pay his way instead of taking personal responsibility.

"I'm willing to pay for this," he added as if he had read her thoughts. "But I still need somebody to explain why I'm getting so many bills. Doesn't Dave's Center cover everything?"

Tonya sniffed. "Dave's Vehicular Treatment Center only provides facilities and support staff, sir. All of our resident specialists have their own practices and are simply certified to practice at Dave's Vehicular Treatment Center. Each specialist does their own billings. It's much more efficient that way!"

"But why did I get a second mechanic's bill? I only wanted somebody to look into the rattle, for God's sake! That shouldn't take two people!"

She touched the keys to bring up some more records. "I see here that your primary care Mechanician required consultation and our on-call resident came in to assist with the diagnostic procedure. Oh, I see here that he also dropped by the next day to check the car."

"Yes, and he drove it one hundred

miles, charged me for gas, and what looks like five hours of his time as well. What the devil did he do, go shopping with it?"

"There's no need to be huffy with me, sir. I just work for the billing department. I'm certain that our resident Mechanician had some very good reasons to drive your car." She paused for a moment. "If you really have some questions about this perhaps you should ask him directly."

"I've called his office a dozen times but he's always out. They said I could make an appointment to see him in a couple of months, if it was urgent. A couple of months—can you believe that!"

"Was there anything else, sir?"

"Yeah, is there any credit plan? You see, I can't afford to pay all of these bills at once. Is there any way I could just sort of, uh, stretch them out?"

Tonya shook her head sadly. "You *really* should have had auto maintenance insurance coverage, sir. I know that the premiums look like a large monthly payment, but it's worth every cent when something catastrophic happens to your car. You really do need the coverage."

"You can say that again. Boy, I never expected a simple problem like that to cost me this much. I never expected that it would take a half year's salary to fix a damn rattle that probably wasn't anything serious. And I'm *still* not certain exactly what they did to my car."

"Now I know that the symptoms may have appeared to be something trivial, but one never knows," she replied sympathetically.

"But this wasn't anything catastrophic, nothing serious—it was a little noise," he protested weakly. "It was just a little rattle, that's all it was!"

"Was there anything else, sir? I have another call on the line."

After a momentary pause he said. "Yeah, what's this item called an 'O.&L'?"

"Oh, that's an oiloscopy and lubricotomy! The Mechanician must have decided that an O & L was needed. I see that one of our own fluidologists worked with the Mechanician to ensure that it was done properly."

"Is that why it took so damn long?"

"Partially, sir. You see, after we complete the O & L on your vehicle, we require our caregivers to check on things like oil pressure, compression, belt tension, temperature, and all of the rest. We take very good care of your car until you come to check it out."

"I suppose I'll get another bill for those services as well," Carroll said dryly.

"Oh, no sir, that's a free service we provide," Tonya said brightly, glad to finally be able to tell the man something positive. "It was included in our parking fee!" ■

ROGER ZELAZNY

1937-1995

Roger Zelazny, a prolific and much admired writer often identified with the "New Wave" of the 1960s, died June 14, 1995, after a lengthy struggle with cancer. Born in Cleveland, Ohio, he spent his last two decades in Santa Fe, New Mexico, and died in St. Vincent's hospital there at the age of 58. With degrees in English from Western Reserve University and Columbia University, he was an active writer until his death, well known for experimenting with a wide range of styles and techniques. Numerous awards, including several Hugos and Nebulas, testify to the success of those experiments.

His contributions to *Analog* were few but memorable, including the novel *Doorways in the Sand* and the novella "Home Is the Hangman," which won both Hugo and Nebula awards. He is perhaps best known for the very popular "Amber" series of fantasy novels. Both he and his work will be long remembered by those who knew them, and Roger Zelazny will be very much missed.

TECHNOLOGY AND THE NEW ARCADIANs

In the late 1950s and early 1960s, the field of "technological forecasting" was in its heyday. People such as Herman Kahn, Dandridge M. Cole, Robert Prehoda, and I were actually paid good money to think about future technologies and forecast what could be achieved by applying them. In many ways, we acted like science fiction authors except that our output wasn't considered fiction. Many of the top technological forecasters didn't assume that mantle; people such as Robert A. Heinlein, John W. Campbell, Jr., Gene Roddenberry, and Arthur C. Clarke kept right on doing what they had been doing as well as teaching the newcomers what they had learned in the process. As Larry Niven has observed, science fiction authors are the future planning department of the human race.

Sadly, many of the Old Masters are now gone with the exception of Arthur Clarke and Bob Prehoda (whom I've lost track of). We learned a lot during those years of technological forecasting. The Flower Power Revolution of the 1960s and 1970s put technological forecasting out of style. However, with the mellowing of the modern romantic revolutionists who

discovered that technology was something they really couldn't live well without, technological forecasting has again started to blossom.

Some of the new forecasters—most of them come from the academic, intellectual, and artistic side of the house—are trying to guess what the romantic revolution of the 21st century will be like. One of them calls it "the New Arcadia."

In Greece, Arcadia is a central plateau of the Peloponnesus isolated from the coast and surrounded by high mountains. In classical times, the inhabitants of Arcadia lived simple lives, untouched by the progress that marked the rest of Hellas.

That should be a strong signal relating to just what these new forecasters are thinking about. Basically, it's the same old philosophy of the 19th century romantic movement—back to the land to become shepherds—and the 20th century's anti-technology—small is beautiful and technology sucks. (Actually, this can be traced back to the Old Testament where the Rechabites and Hosea summed up Yahweh's attitude against progress and the evil cities that developed as a result, "I will yet again make thee to dwell in tents.")

And, indeed, this appears on first glance to be the vision of the New Arcadians.

They imagine the world of the next century where technology disappears as a physical presence and becomes more and more an omnipresent background magic. They want to see technology sinuously and stealthily adapted to culture and nature. Nothing wrong with that, except that culture usually adapts to technology and the natural way of doing things becomes altered by the Biological Law of Least Effort. In this regard, the New Arcadians forecast industry as turning out small, light, multipurpose, intelligent, cheap, charming, and recyclable products. In many ways, this happens now in response to market forces. However, they forecast the corporation as becoming a campus, a think tank, and a theater for playing out life-styles and alternate futures. I sincerely wonder if any of them have actually worked for a corporation.

Because they claim we're moving into an information-based culture rather than one that is labor-based, they warn about the creation of a new underclass, a group of people who can no longer sell its labor because of a lack of demand. Again, in mild rebuke, all of us know that someone must labor to design, test, assemble, repair, and maintain things that depend upon technology.

The romanticists have indeed learned something over the last two centuries, however. They realize they can never attain Utopia but should work toward a type of culture in which new possibilities are always opening

up and new problems and challenges are always arising. How this will come about against their background of small, magical technology is not specified. But they appear willing to learn.

They deplore the possibility of living in some metallo-concrete technodesert. Well, they don't have to do that even now.

And because they don't seem to have a cogent philosophy to provide a rational foundation for the New Arcadia, they forecast a return to nature-based religious forms—animism, totemism, ritual sacrifice, and seasonal fertility rites. (Ayn Rand is probably laughing hysterically in her grave at their forecasted resurgence of the Witch Doctors.)

This sounds like something right out of 1950 with the words altered and semantic spin introduced to make it sound modern and futuristic. So why is it surprising? The New Arcadians have read about George Orwell's *NewSpeak*, too.

A few things are basically wrong with all of this from the viewpoint of one who has studied the progress of civilization and the growth of technology over the last hundred centuries. This has been a hobby of mine engendered by my interest in writing speculative fiction because it's impossible to think about where we might be going without knowing where we have been and how we got to where we are right now. In many ways, forecasting the future is like navigating by dead reckoning.

One of the most profound books relating to the human future was written by an anthropologist, the late Dr. Carleton S. Coon, whose work, *The Story of*

Man, (1969, New York, Alfred A. Knopf, Inc.) has been largely forgotten because of the controversy he stirred up in his other books about the nature and development of the races of mankind. As a person who studied human beings and the development of their institutions, Coon had some important basic concepts about human development that few people seem to have grasped.

First of all, Coon observed, "man has been converting energy into social structure at an ever-increasing rate. As he has drawn more and more energy from the Earth's storehouse he has organized himself into institutions of increasing size and complexity."

We will continue to do this because we now *need* worldwide social institutions in a world of nuclear, chemical, and biological weapons. The most powerful institutions are centered in those cultures where per-capita energy expenditure is greatest. The amount of energy required to lead a tribe of nomads is far less than that demanded by multinational organizations.

The role of technology in this process is multifold:

(a) We will learn to use energy more efficiently so that less waste results;

(b) We will use more and more energy as our international institutions multiply to keep most of us from killing most of the rest of us most of the time;

(c) The energy densities that our technology allows us to handle will continue to increase so we get more ergs in less volume for the same amount of effort; and

(d) Although we have only scratched the surface of the Earth's en-

ergy resources, we may find it more economical to expand this activity into the Solar System where the consequences may be perceived as less harmful to our home world.

Utilizing energy to develop our complex social structure implies the development of technology and the increasing use thereof. I seriously doubt that we will see smaller and less obtrusive technology except at the most advanced edges of the state of the art. New technology to support new industry must rest upon existing technology and the industries that have been developed to use it.

In short, the steel mill isn't going to go away although it may become more economical to move it into the Solar System. Why? Because for the past 5,000 years or so, our growing civilization has depended upon one specific element: *iron*. Yes, we have begun to utilize other non-ferrous materials, but our technology is built on iron.

I used to have some fantastic debates, private and public, with Dr. Herman Kahn about his "post-industrial society." I maintained there was no such thing because we would always need the existing industrial base to provide the foundation for new industries. Herman passed away in 1983 before the present communications revolution really got rolling, and that has certainly changed the *way* we do business but has not eliminated any of those ways. Arthur Clarke and I have a friendly argument going because I maintain that all of us are not going to sit around in front of our terminals communicating with one another. Someone, I point out, must still milk the cows—or hook

up, clean, and repair the milking machines. And make new ones to replace worn-out old ones. And get the milk to market before it turns sour.

And, because of the communications explosion, we are *not* going to be able to isolate ourselves as the Arcadians did. Whatever we are evolving into as the civilization and culture of the 21st century, it is certainly *not* Arcadian!

While we should welcome the inputs from people who have hitherto been non-technologist artists from the other side of C.P. Snow's *Two Cultures* dichotomy, it behooves us to inform these newcomers about some of the important things we've learned and they've never had the chance to find out about. It appears at this juncture that the New Arcadians are not confrontational although they may be controversial. That's good. We can handle that! We have a lot to share with them, and they seem willing to learn. And we can learn from them as well lest our cities indeed become technomegaliths. We need to make sure that the failed concepts of the past don't contaminate the workable principles that have survived the test of time. "Been there. Done that." The philosophies that became the foundations for the early city-states and empires as well as the recent Marxist-Leninist doctrines have now shown themselves to be untenable. (The current excuse is, "We didn't try hard enough and we couldn't get everyone to cooperate!") Regardless, they are now unworkable in a world of industrial marketing, fast-developing technology,

and rapid communications.

Of course it's a Red Queen's race! It always has been! Be glad it is or you will find yourself living in a world of "again-and-again" where each day is just like the one before it, and the one before that, too. And tomorrow promising to be no different. How boring!

Technology isn't going to get smaller, although some new parts of it will; it is instead becoming more pervasive and more interconnected. The situation is going to become far more complex. It may appear at times to be chaotic, but most dynamic systems do. We are a mega-organism that has discovered it has the power to act like the gods of old but has also learned not to commit suicide; the last 50 years have clearly shown that, if the Cuban Missile Crisis itself didn't. And, as a mega-organism, we have just learned we can communicate within this organism as never before.

As forecast in the June 1984 column, we are at the Millennium. We are seeing great changes. We are seeing fantastic new opportunities. But, like the navigator of a ship, we must proceed into the unknown future fully aware of the rocks and shoals we've avoided so we can properly handle the ones still hiding out there before us.

While the New Arcadia appears to be based on some wishful thinking and retreaded concepts dressed up in new words, our technology, communications skills, and human compassion can be used to make it into a workable reality that we can all live with and prosper in. ■

Ian Randal Strock
**LIVING IT IS
THE BEST
REVENGE**

LICENSED TO UNZ.ORG
ELECTRONIC REPRODUCTION PROHIBITED



*"To see
ourselves as
others see us" is
not always a
welcome gift—but
it may be a
beneficial one.*

Illustration by Mike Aspengren

Mark was walking to the subway station at a brisk pace. It was late, and he wanted to get home.

The sidewalks were wet from the rain, but fortunately, it had stopped before he left the office, since he'd forgotten to bring—

His back was on fire!

Then he felt cold as ice.

He dropped his briefcase, and felt the sidewalk rush up at him. Then a hand rolled him over onto his back, and he saw a shaggy young man with a bandanna tied over his nose and mouth. The young man was holding a shiny black knife.

Mark tried to say something, but his mouth wouldn't work.

The young man checked each pocket, removed Mark's wallet, and started to walk away. Then he stopped, turned back, and wiped the bloody knife on Mark's jacket.

Mark moaned in pain, and tried to call for help.

The sound of footsteps brought him back to himself.

A woman screamed, and a man hurried out of sight. He returned moments later and said, "Lie still. An ambulance is coming. You're going to be all right."

Mark's first ambulance ride was a confusion of sights and sounds as he faded in and out of consciousness. The paramedic stabbing his arm with a needle. The siren. The ambulance lurching from side to side. The paramedic screaming "Faster, Joe! He won't hang on much longer!"

Then the flickering of light and not light in his eyes as he was wheeled into and through a hospital. Then, a black gas mask came down over his face.

"Mark, can you hear me?" Ginny's face was tired and streaked with tears. Her hair was messed—mussed, she would say—and she was sniffing as she held his hand to her chest.

"Ginny," he said, or tried to say.

"I'm here, honey. I'm here. I was so worried."

"Ginny, I'm very tired."

"Of course you are, darling. You rest. I'll stay right here."

"Mr. Taylor? I'm Dr. Schoenfeld. I'm the one who operated on you last night. This is Detective Morrow."

"What am I doing here?"

"Do you remember anything about last night?" Morrow asked.

He turned his head, and saw Ginny holding his hand. She looked like she'd been up all night.

"I was working late in the office. I was walking to the subway, and glad it had stopped raining, because I'd forgotten my umb. . . ."

"And then what?"

"Then, then . . . I . . . felt this incredible pain in my back. It was like I was burning up, and then freezing, and I fell down."

"Yes?"

"And a . . . a man . . . with a bandanna on his face . . . holding a knife, he took my wallet."

"Do you think you'd recognize this man, Mr. Taylor?"

"I . . . I don't know. It was dark, and

I wasn't thinking too clearly, and . . . could I have a drink of water, please?"

"Of course, Mr. Taylor. Detective, please don't tire him out. Mr. Taylor's going to be with us for a few days, yet."

"Doctor, we're holding a man right now. We think he's the man who attacked Mr. Taylor. But if we can't officially charge him with anything, we'll have to release him soon. If Mr. Taylor could swear a complaint, we'd have sufficient grounds to hold him."

"All right, Detective. What do you need me to say?"

A nurse was whispering with Dr. Schoenfeld by the door.

"What is it, Doctor?"

"You seem to be having a reaction to something, Mr. Taylor. We're not quite sure why you still have a fever."

He had been feeling worse today, rather than better. Mark started to feel nauseated again, and reached for the bucket barely in time.

When he stopped heaving, and had rinsed his mouth, the doctor said, "We're going to have to do some blood tests."

Mark held out his arm resignedly, as the nurse returned with a needle and some test tubes.

Mark was shivering and his whole body ached, as Ginny brought the kids in to see him.

"Daddy, Daddy," five-year-old Maggie cried, as she saw him lying there. "You have to get up. You have to get better. You promised!"

Mark Junior, who was twelve, was more reserved, but in his eyes, Mark

could see the fear of death. It made him shiver even more.

"Ginny," Mark mumbled.

"I'm here, honey," she replied, patting his hand.

"I'm so tired, babe," he barely whispered.

"Then sleep, Mark, sleep. It's OK, I'll be right here."

"OK," he said, and faded into unconsciousness.

"Did the prisoner know he was going to experience this?"

"The State Supreme Court allowed our experiments, but said we could only try the system on volunteers, and that if a psychological interview after the treatment agrees with our assessment, commutation of their sentences would be possible. Ethically, we decided we also needed the permission of the victims. In this case, Ginny gave permission. Of course, all the emotions and feelings may not be precisely what they felt at the time. . . in some cases we've had to make best guesses, but overall, the feeling is close, and the results are quite good."

"So after he's experienced the death of Mark. . . ?"

"Then he'll experience the grief of his loss as felt by Ginny, and by Mark Junior, and by Maggie, and everyone else involved."

"Mrs. Taylor?" It was a voice that sounded like bad news.

"Yes?"

"My name is Dr. Schoenfeld. I'm at City Hospital. Your husband was just brought in, and . . . well . . . I think

you should be here."

"Oh my god!" Ginny screamed.
"What happened?"

"Please, Mrs. Taylor, it will be easier to explain in person."

"I'm on my way."

"Judy? This is Ginny. Yes, I know it's late, but I have to bring the kids over. The hospital just called. Mark is there, but they wouldn't say why. No, I'm not OK, but I need you to take the kids so I can get to the hospital. We're on our way."

"Come on kids," Ginny said, as she helped them put their jackets on over their pajamas. "You're going to stay with Sam and Joanne. I have to go see Daddy."

"But why, Mommy?" asked Maggie.

"Because he fell and hurt himself, and now he's in the hospital. I'm going to go get him, and bring him home. But it may take a while, so you're going to sleep at Sam and Joanne's house. Now come on, we have to get going." *Move it!* she wanted to scream, but she couldn't. It hurt to lie to them, but she had to get to the hospital *now*.

Ohgod, ohgod, ohgod!

Mark's been hurt!

He's dying!

He's *dead!*

Gotta get there, gotta get there, gotta get there.

The red and blue flashing lights in the mirror made Ginny slow down. *No!* her mind screamed, *Mark needs me!*

"Do you know how fast you were go—"

"My husband's in the hospital! He needs me! I have to get there! Please, I have to get there *now!* They just called. Please."

"All right, all right. Slow down, lady. I'll let you off with a warning, this time. But don't go speeding, or you'll be a patient, too."

"Thank you, officer." She rolled up her window, and tried not to speed away.

"My husband. I have to see him."

"Excuse me, ma'am. Are you all right?"

"My husband! You called, said he was here."

"Who called? What's your husband's name?"

"Mark. Mark Taylor. My husband's name is Mark. Dr. Schoenfeld called me and said I had to get to the hospital. Had to be here."

"All right, Mrs. Taylor. Have a seat over there, and I'll see if I can find Dr. Schoenfeld."

"I have to see Mark *now!*"

"I'll go get Dr. Schoenfeld, Mrs. Taylor."

"Mrs. Taylor, your husband was stabbed. He came through surgery just fine, and he's in the recovery room at the moment. We couldn't wait for permission to operate, but there are some forms we need—"

"I don't care about forms. I have to see Mark!"

"As I said, Mrs. Taylor, he's in the recovery room. He should be there for a few more hours. After he wakes up, we'll take him to a room, and you can stay with him."

"But I have to see him!" Why couldn't this doctor understand? Why couldn't anyone understand? She had to see Mark now. To make sure he was OK.

He looked so weak, so fragile. Lying there with tubes stuck in his arms, and wires attached to his chest. Her cheeks felt wet, and her vision blurred. *Why wouldn't he wake up?*

She was so tired, sitting here holding his hand. So tired, but so wired. She couldn't even think about sleeping. She had to watch Mark, make sure he was going to be OK.

Why wouldn't he wake up? The doctor said he'd be asleep for a while, but he didn't say how long a while.

She glanced at her watch, then out the window. It was getting light. Have to call Judy soon, she thought, and have her help the kids get to school. Explain to them on the phone.

"Why me? Why him? Why *us*?" she sobbed softly.

His eyes were fluttering. Maybe he was waking up. "Mark? Mark? It's me. Mark, wake up!" His eyes stayed closed.

"Mark, can you hear me?"

Finally, his eyes opened, and seemed to focus on her.

His lips moved, and he seemed to be saying "Ginny."

The fist that had been squeezing her chest since Dr. Schoenfeld called finally released its grip.

"I'm here, honey. I'm here. I was so worried." *How dare you let yourself*

get hurt like that! she wanted to scream.

"Ginny, I'm very tired." His eyes started to close again.

"Of course you are, darling. You rest. I'll stay right here. I won't let anybody hurt you again. I'll be here, you rest."

He was already asleep.

"Judy? It's Ginny. Mark's going to be OK. He was stabbed. I'm with him now. I'm calling from the phone in his room. He woke up a few minutes ago, and recognized me, and then went back to sleep. Look, I have to stay with him. Can you get the kids to school? Thanks. Tell them something?"

The doctor walked into the room, followed by a small man in a brown suit. The small man was holding a notebook and a pen.

"Mr. Taylor? I'm Dr. Schoenfeld. I'm the one who operated on you last night. This is Detective Morrow."

"What am I doing here?" Mark's voice was weak, but recognizable.

"Do you remember anything about last night?" Morrow asked.

What are you doing here asking questions? Ginny wanted to yell at him. *Go find the bastard who did this!*

He turned his head, and saw Ginny holding his hand.

He looked so small and weak. *What happened to the big, strong man who went to work yesterday morning?*

"I was working late in the office. I was walking to the subway, and glad it

had stopped raining, because I'd forgotten my umb. . . ."

"And then what?"

What were they talking about? Mark was lying here with a hole in his back, and this detective wanted to know about his walk to the subway?

"Then, then . . . I . . . felt this incredible pain in my back. It was like I was burning up, and then freezing, and I fell down."

"Yes?"

"And a . . . a man . . . with a bandanna on his face . . . holding a knife, he took my wallet."

"Do you think you'd recognize this man, Mr. Taylor?"

"I . . . I don't know. It was dark, and I wasn't thinking too clearly, and . . . could I have a drink of water, please?"

"Of course, Mr. Taylor. Detective, please don't tire him out. Mr. Taylor's going to be with us for a few days, yet."

"Doctor, we're holding a man right now. We think he's the man who attacked Mr. Taylor. But if we can't officially charge him with anything, we'll have to release him soon. If Mr. Taylor could swear a complaint, we'd have sufficient grounds to hold him."

"All right, Detective. What do you need me to say?"

He'd been lying there, shivering, and not getting any stronger. Maybe showing him the kids will help, she thought, and went to the waiting room.

"Come on, kids, we're going to go see Daddy. Now, remember what I said: he's been hurt, and he's not feeling very good, so he looks kind of sick,

and he's very weak." Maggie's eyes were huge, and Mark Junior looked angry. "He's going to be OK, but he's going to be in the hospital for a while."

She knew that if she said it enough, believed it enough, it would happen. It *had* to happen. Mark *would* get better!

Mark was shivering, but he smiled when they walked in. He would get better; she knew it.

"Daddy, Daddy," Maggie cried, as she saw him lying there. "You have to get up. You have to get better. You promised!"

"Now, Maggie, remember what I told you," Ginny admonished. "He will get better, but he has to rest for a while."

Mark Junior was more reserved.

"Ginny," Mark mumbled. His eyes didn't open.

"I'm here, honey," she replied, patting his hand. It felt cold and weak.

"I'm so tired, babe." She struggled to hear him.

"Then sleep, Mark, sleep. It's OK, I'll be right here." *And I'll kill anyone who tries to hurt you!*

"OK," he said, and faded into unconsciousness.

An hour later, he stopped breathing. Ginny wasn't sure at first, but then an alarm went off, and a nurse came running.

Ginny looked at her face, and screamed in pain.

"Come on Mark, you have to wake up."

It was dark as Mom shook his shoulder. He rubbed his eyes and looked at her.

"Why, Mom? Is it time to go to school already?"

"No. Daddy was hurt. I have to go to the hospital to be with him. You and Maggie are going to stay with Sam and Joanne. Come on, you don't have to get dressed. Just put on your sneakers, and put your coat on over your pajamas."

"You see, the perpetrator is going to live, through our Live-It system, the lives of each of his victims. He'll experience all the feelings of every person who suffered for his crime."

"And when he's finished?"

"When he's gone through each of them—in this case, that means Mark, the victim, his wife, his two children, both his parents and his in-laws, and his business partner—then we run him through a simulation where he is himself with the same opportunity he had when he committed the crime. If he commits it again, we run him through the whole cycle again."

"And he keeps living through all their lives until there is some change in him."

"And if there is no change?"

"Then this will amount to a life-imprisonment. Life as a victim of a stabbing and robbery, over and over again."

"And do you think he'll be here for life?"

"Oh, no. Most of the young criminals that we've tested the system on, early in their careers, are usually turned from a life of crime after two or three repetitions."

It was cold and dark, and the wind was blowing through his thin coat. He shivered. At least the bandanna over his nose and mouth helped keep a little warmth in, and holding the handle of the knife in his pocket was a comfort.

A man was walking toward him. A man in a suit and warm-looking overcoat, carrying a briefcase. He was hurrying, and the sound of his shoes on the pavement was almost like dog toenails on tile.

It was so cold, and he was so hungry. He needed some money for food, and maybe for a better coat, or a place to stay. The suit looked like he had plenty. Surely it wouldn't hurt to ask him for some.

Of course, moving that fast, the suit would never stop for him. But he had the knife. . . .

Then he thought of the suit's—no, not the suit's, the *person's*—wife and kids and family. Was it really worth that man's life for the few bucks in his pocket?

"Hey, mister," Tommy called out to him, "you know where the homeless shelter is?" ■

Let a smile be your umbrella if you want, but it's better to come in out of the rain.

—Kelvin Throop III

In Randal Strock's mother decreed that he should pronounce his name "Eye-an," and he goes through life correcting any deviation like Coca-Cola protecting its trademark. Born in Brooklyn, he also grew up in Milford, CT, and a suburb of Buffalo, NY. After graduating from Boston University, he returned to Brooklyn—New York City is the place to be if you're determined to work in publishing.

A BA in political science was augmented with a lot of courses in the physical sciences. Would-be writers universally display profound curiosity about nearly everything, and always supplement formal studies with self-directed learning. Ian says that most of his learning at BU came outside the classroom. An important part of this was seeing firsthand how humans manage social organizations. He was twice elected a college senator, chaired the blood drive for three years, and was active in a multitude of other student affairs, including the school paper. A Mensa member, Ian has become president of Greater New York Mensa.

The usual unexpected assortment of jobs piled up before Ian joined *Analog*: busboy at a country club, bilingual English-French tour guide at Niagara Falls, typist, bookstore clerk and assistant manager, and systems analyst at a large bank. Ian's first career job

came as Editorial Assistant, later Associate Editor, of *Analog* and *Asimov's*. "Chance favors the prepared mind," said Edison. Having submitted several stories to *Analog* and *Asimov's*, Ian jumped at the chance when he recognized the address in a blind *New York Times* ad for an Editorial Assistant.



Photo by Kit Hawkins

Ian Randal Strock

Ian's first SF story was written in the sixth grade, but it wasn't until becoming an editor that he started to attend SF conventions and meet SF fans. After five years of what Ian considers a dream job, he read Greg Bennett's *Analog* submission for an article on the Artemis Project. They met at the 1994 world SF con in Winnipeg, and after working as a Project volunteer,

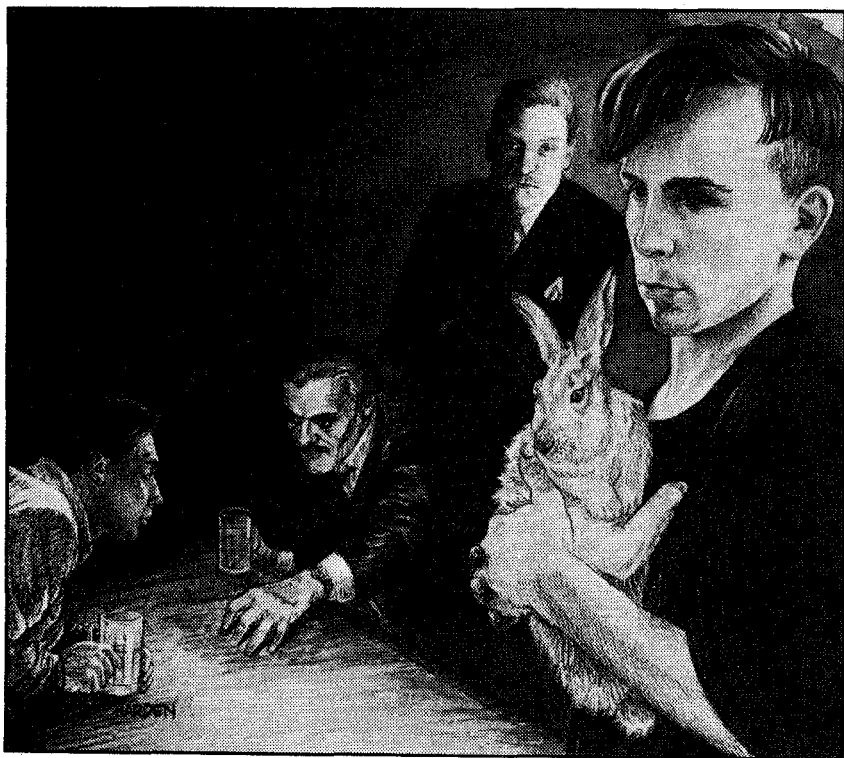
(Continued on page 153)

Mark Rich

HUMAN LIVES SAVED

*There are those who would reduce
everything to simple slogans—but human
lives are anything but simple!*

Illustration by Laurie Harden



"Shot you?" she said.
I guided her fingertips to the wound.

"Oh, Fred," she said.

"When?"

"At the end."

"When he—?"

I nodded before remembering her long witness upon night: Veronica could bear and feel, not see.

"Yes," I said. "Before he gave up. It made him give up."

Then, after a longer moment: "No. No. It didn't. How can I say that? It was me. Me. I made him give up!"

I said this and felt glad she could bear and feel, not see.

He stood at the plate window with hands entwined gently at the back of his tweed, an Auguste Rodin bronze named Contemplation, in corporate clothing.

He watched those outside.

From where I stood I could see their signs: *We're Animals Too! Prevent Cruelty! Don't KILL For CURES.* They gathered Friday afternoons and Saturdays in an average week. Today they mustered at mid-week to coincide with media coverage of a breakthrough. Of what level of breakthrough, they possessed no knowledge. Cameras would soon cover building and grounds; lenses might light briefly on bodies, faces and signs; and a few of the crews might nod their heads to hear a word, thrusting a microphone forward. That mattered; nothing else.

We had released nothing to attract them; at least nothing beyond essentials, only hinting a major story was

in the wind.

Robert Means's shoulders shifted slightly—not in a sigh, for Robert never sighed, to my knowledge, but in the barest of shrugs, as a kind of physical signal: he had finished a thought.

"Do you think they'll be surprised?" I said.

He looked at me. People misjudge him by his appearance. He carries barely a pound of extra flesh on his body, both due to physical regimen and metabolism; yet he appears, at first glance, as a soft, overweight man, one whose gaze over the twilight years made him opt for luxury while luxury still possessed meaning. His face rounds outward. People usually change their estimations, seeing the normal physique below: but that face, with its cheeks, its fleshy chin, even its slightly fleshy brows, give the uncanny sense of being a mismatch. It throws people. Sometimes Means uses that off-guard moment to get past the defenses of opponents.

"Surprised?" he said, lifting the corners of his full lips. "I suppose so. Though they may not get the point."

"Expectation of conflict?" I said.

"Yes."

We had talked of it before, how you can agree with someone who expects a fight, and despite agreement still be forced into fighting.

"I'd think it would please them."

"So would I. By the way, Fred, I hear of a coincidence—that it's Tony's birthday. Maybe we should take him for a beer. We could go to Joe's. Eighteen, is it?"

"Still not old enough to take him to—"

"If it was old enough for us—"

"Laws change."

"Quicker than human nature, yes, they do."

I tapped a finger on the sheaf of replies I had set on his desk. "Here's what I really came in here for," I said. "List of who's coming. Several papers, one interactive, and two TV stations. Maybe some freelancers, maybe some magazine staff. Should be a good session."

"Good. You think Tony's up for it?"

"The press conference? He'll be a hit."

"No, I mean for Joe's."

I laughed. "Robert, he isn't old enough!"

"I have an I.D. to say otherwise. I think it's time he met our man."

"I don't see why—"

"Yes, you do. He should meet Joe. And no better place than there. Or time than now." Robert looked piercingly at me. "What do you think? Don't you think it's time Joe came back to us?"

Like a punch in the midriff in the middle of a joke: he took me by surprise.

"He won't," I said, and felt a tightening, and a sadness, at the thought.

"Not just laws change," Robert said. He returned to the window to gaze outward. "Maybe even these people will, sometime." After a moment more of contemplation he lapsed into one of his thinking-aloud spells. "If only they would *think* about how to approach the whole question," he said quietly, "instead of going at it all the time as if it was all a matter of heart. *Then* they'd see how much the

medical establishment is holding up paper arguments based on heart strings, too. Both sides are culpable, is what I say. 'Human lives saved.' You've heard that one, right?" He turned to me. " 'Human lives saved.' 'Chimp research saves X-number of human lives.' The chimps die, of course. And so do all the humans, eventually. That stink about prostate cancer prevention. Remember? Decades of research into prostate cancer, Fred! Animal studies up the w-zoo! And what came of it?—men were subjected to radical treatments—and they were treated *successfully*—and the doctors could proudly and truthfully say: 'X-number of human lives saved.' "

"Sounds like good science."

"It does. Sounds great till you learn that, yes, lives were 'saved,' but that once 'saved' those men lived an *average* of one-half to one and a half *days* longer. That's an *average*, Fred. The misery! The pain of those men—and those animals! For the sake of saying 'X-number of human lives saved!' "

"You're beginning to sound like your opposition!"

"No! Exactly the opposite! I *know* the difficulties."

"Of course," I said, "it all may change." I had Tony's work in mind. "The point may become moot."

"Or get worse," he said. I sat morosely self-absorbed, unlike the driver and two other passengers in the semi-PV we rode downtown from the labs.

The press conference went strangely well. The simulated tissue dissection had the med-reporters going nuts. A computing magazine's re-

porters materialized despite having said they would skip it: and their hands ended up typing on pads like teams of sprinting spiders.

We had all harbored worries: things invariably go awry, when a project that works in the privacy of a laboratory moves onto the public stage. Expected results come off cockeyed; models break down; excitement simmers and then cools to disappointed afterthought. This time, however, the demonstration flew like crazy. We all felt the wildness in the air and the utter astonishment of the media; because this *worked*. It felt like a shot of adrenaline straight into the cerebellum. How could we not glow at the babbling, frenzied reaction? Tony moreover shined like a zillion-watt lightbulb. The kid's charm and brights shimmered like marquee lights down Broadway. The crews from the papers and news and science press lapped it up, kittens at a cream-cup. I loved to see it.

"You know what's our big problem?" Robert Means said.

He sat in the driver's seat. Meg Astor, a cell biochemist and systems modeler who has turned herself toward issues in linguistic structure in the past decade, sat next to him. Veronica Speller, six years my senior but with natural color in her hair considerably less streaked with respectable gray than mine, and a mathematician of the first candle, held my hand in the back. Me, I rank among the tops in human interface system development, thanks to Robert's guidance over the last six grueling and intensive years. We made a brilliant car-

load—just about half the brains of the outfit called Med-Dyne, unless, as I worried sometimes, *Tony* had half the brains of the outfit all by his lonesome. *What* a lonesome that would be.

Brilliant as we were, no one answered him.

I thought about Tony's enthusiasm. It communicated to everyone, yes. *What* had it communicated, however? I realized how the media might have seen the boy—no, *must* have: as a bright but wacko kid. He waxed with a high-vibration mania over Hocus.

Hocus: Meg Astor's pronunciation of "Focus Automaton" early in the project had planted the name in Tony's noggin. It went by the handle of Hocus from just about day one.

Verry must have been thinking along similar lines, for she smiled faintly. I wondered if she might be remembering holding Hocus during the press conference.

"It's the rabbit," she said.

"Hocus was perfect," I said.

"*Tony* and Hocus," she said.

Verry wore clear, wire-rim glasses today. Blind since birth, she had fallen early into the habit of hiding her eyes, a practice encouraged by those around her: it served as an identification-tag to the seeing. After I told her how lovely her eyes were, even though she would never see herself, she bought clear plastic lenses. She would never concede to doing away with eyepieces entirely. They had become an identification-tag within herself, too.

I never pressed the point. She looked lovely in glasses, too.

"No, no," I said. "Tony was perfect, too. Absolutely wonderful."

"He *was* wonderful," she said.

"So how can you say Tony and Hocus are a problem?"

Meg looked back at us. "Because—maybe we're thinking the same thing, Verry—because it looks so *screwball*. And it *is* screwball. My god, the kid is stuck on rabbits!"

Meg spoke with some difficulty. While still young she had suffered nerve damage equivalent to a light stroke; the doctors could identify no direct cause. She lost control over some muscles of her face.

Before I knew this I thought her the most preoccupied and serious person in the world, since I never saw her fully smile.

I learned better.

"That's just how Tony is," I said. "He's just that way."

"Sure he is," Meg said.

"So he was a little excited—"

"Excited! Jumpy just *like* a damned rabbit!" she said.

We laughed at that. Had to. Tony, who was living a childhood dream of creating an artificial animal, and who had the brights to enable a project with precisely that aim and sufficient maturity to see it through to fruition, had the temperament and nervous energy of exactly the animal he chose to fabricate.

"And the whole thing," said Meg, "is his inability to get beyond rabbits. He doesn't *want* to look beyond. It's rabbits this, rabbits that!"

"There *are* things to clean up in the programs," said Verry. "Probably always will be. If he wants to, he can do

rabbits all his life. He's created an entirely new industry."

Robert shook his head. "I wasn't talking about Tony."

He pulled the car around the corner. In another block we would be in sight of the bar. Tony and his mother followed somewhere behind us.

"Tony isn't the problem," he said.

"Then *who* is?" I said, wondering if I should have said "*what*."

Robert glanced at me in the rear-view. "Joe," he said. "Joe's our problem."

That froze things tight, right there. In the car and in my gut.

Joe bombed out of Med-Dyne. As a kid he showed incredible aptitude for modeling psychomotor interrelations—or not modeling them, but creating the base-sets of rules from which to *grow* muscular systems—something of which I had no understanding at the time, though I now did, and he looked to be headed for the Big One, the kind of project that would make Med-Dyne's star burn in the ascendent and transform Joe overnight from talented, teen-genius computer geek with a hand for biological engineering into an acknowledged, world-class leader in self-organizing automaton, overnight.

It *would* have been overnight. He dropped out before nightfall.

An accident, a bizarre mistake, a moment of violent passion: call it what you will. He caught a glimpse into the blackest corner of his own soul and grew alarmed—deathly alarmed—and backed out. Gave up on his brain. On his abilities. On his promise. On the project. Everything.

He picked up a gun and shot his dad.

Now he ran a bar.

Everyone in the car stared at me.

Robert kept his eye on the street as we wheeled toward Joe's place; Meg looked out the side window; Veronica for heaven's sake could hardly stare, being blind and having her clear-plastic lenses pointed forwards.

Yet they did. They *stared* at me.

"Here we are," Robert said, pulling the car to a stop and cutting the hum of the motor so the others could hear the thudding and pounding of my own internal engine.

"Don't put it that way," said Verry.

"Why not? It's true," I said in the darkness.

In the bedroom I sometimes shut the door, jam the rug against the bottom crack, and pull the shade to the bottom, to gain a delicious taste of the uttermost night in which Verry operates at all times. At bedtime, when we share everything else, I want this, too. I fail in it: always do. Light seeps around the door frame and the edges of the shade; and if I shut my eyes, within seconds I see patterns of light etched there by retinal memory.

"It's true," I said again. "I was an utter asshole! Or I was worse than—"

"But you're a gentle man. I know this. You're 100 percent a gentle man. I wouldn't be here if I didn't know that. So how can you change from what you say you were, to this?"

We leaned against each other in the bed, our skin touching, my left

arm over her, her right over me. Our heads sank against the pillows, weighted by a long day, by feelings, by thoughts, by comfort. Intimacy includes a thousand shadings and more, only a few of them active and sexual—something I failed to learn with my first wife.

"Maybe I didn't," I said. "I feel like after that—after that shock—I fell apart. I had to put myself back together. And it wasn't me doing the re-constructing. It wasn't Robert either, though he certainly helped. He helped a lot. It was as if I was made of a million blocks, and the first time I piled them up, I blew it; and once I made a few mistakes, then I made more, and more. And then—but then the blocks toppled, and I had to pile them up again. Did a better job this time."

Or the underlying rules—the parameters for self-construction—they rebuilt me more soundly.

Such is the way I think, ever since Robert turned me around.

Tony and his mother Twilla stood on the sidewalk, two patches of color against the gray of the doors at the Fox Theater.

Twilla, a small woman with straw-yellow hair, played with the gloves in her hand—I remembered her doing the same during the news conference—and with the straps of her slim black purse. She had a good many such nervous gestures, making me wonder if Robert had tested her for unused aspects of the mind.

Tony made his mother look short, being tall and gangling, apparently

more like the absent father. He grinned crazily at us. He, too, had hand motions: his left hand made short swooping and cupping pulls inward, the way a child's might who imitated catching hardballs—although in Tony's case, knowing his obsession, I suspected it amounted to nothing more than animal-petting motions. In his daily life he walked around with a rabbit in his arms, either a live one or, more often recently, Hocus.

"Are you sure this is an appropriate place to celebrate?" said Twilla in a brittle voice.

She usually felt more agreeable to new ideas than she sounded. A need for reassurance made her a touch querulous, I guessed.

"Of course," said Robert as he heaved himself up from the car seat.

He had no particular extra weight to lift, but did need to fight against an abnormal musculature. Rising from a sitting position had proved a difficulty since childhood. He walked with a cane, but not because he needed any help walking. Just standing.

We must have looked like a case study in misfit groups. Gangling Tony and his nervous mother, both with uncontrollable hand motions; Meg Astor with her serious and half-frozen face; Robert with his disjointed appearance, and his cane; Verry with *hers*; and me.

I look pretty much normal.

When we filed into the Brewtique, Joe looked up with only half the surprise I expected. He calmly went about setting up glasses. The one customer there rose to leave as we entered. I wondered how Robert

arranged it: we had bar and Joe to ourselves.

"Did you catch the news?" said Verry, finding her seat.

"Caught some of it." Joe finished setting up. "You looked good."

"Thanks, Joe."

Joe glanced at me, catching my eye for a second before moving to Robert. "Rounds? Even the kid?"

"I'll have soda," said Tony.

"If he wants," said Robert. "Say, Joe, I hear you might not be the town's last living bartender any more. Another live-tended bar's opening."

"Yeah, I heard."

Five years ago, when Joe dropped out of everything to take over the Brewtique, all other bars in town had converted to coin arcades. You put in an I.D., a dollar coin or two, and got your I.D. and change back if the I.D. was good, and if you were owed anything—unless you wanted to tip. Had to be the oddest part of machine bars: tipping. Presumably the techs got the extras.

Joe showed an iconoclastic streak for one of his generation, bucking trends with his human-run bar.

Its best features survived from days when the town itself was feeling its oats: a wood frame around the bar mirror, of oak; a tin ceiling stamped in patterns of squares, and painted a red deeper than fire-engine and darker than the crimson of maples in autumn; cushioned stools; and a long curve of a bar-top, darkly shellacked, with a brass rail below.

People admired Joe's work in keeping it open. From what I heard, it might have been looking at a profit,

even. Not profit in the way machine arcades raked it in, but profit even so.

"I haven't formally introduced you two. Tony?" said Robert. "Remember I told you about the guy on the life-modeling project before you stepped on?"

Tony nodded, eyes aglow. He heard plenty.

"Well, this is him."

"*Him?*" With a disbelieving eye-over at Joe, who pretended not to care.

"Yes," said Robert. "Joe. This is Joe Staupolos. The town's only living bartender, at least for the time being. Former bright star and genius kid with our project. In fact the high-end project's been on hold since he left."

"What's the matter," said Tony brightly. "Teenage burnout?"

Joe spilled the beer he had been setting in front of me. I know how steady his hands are. I would have spilled it myself. Tony had all the tact in the world—with his rabbits.

In all fairness, teenage burnout we kept as an open topic at Med-Dyne. We thought it worth talking about, because it happens: going too far, too fast, and pushing the brilliant kid until something pops or cracks and the kid leaps out a window.

So when Tony Barbieri wanted to put together rabbits, we gave the nod. We would have just as soon do white mice or frogs: but rabbits would be fine. A big jump for us, but fine. We wanted the young mind to go where it wanted, at whatever pace it needed to go.

Joe gave no sign beyond the few drops of beer. He wiped them up and

filled the other glasses. Robert had straight tomato juice. Twilla drank something with a ridiculous parasol.

"No, not burnout," said Robert on Joe's behalf.

"So, Joe," said Tony, his voice still bright with his youthful cheer, "you were on the *big* project? Wow. I couldn't do it. I mean I don't want to. You saw Hocus, didn't you? I'll be working out testing for Hocus for years. Man, that's enough."

"But the work you're doing," Meg said to Tony, "it's what would make possible work like Joe's. We didn't know before what we know now."

"Yeah, but Joe's work, that's so much bigger."

"It was *too* big," she said, "back then. But it's your breakthrough—"

"That's right," Verry said. "It's a breakthrough, hooking up the processors to work on the real-time modeling of each cell."

"Not a price breakthrough," muttered Robert.

"No, but a performance breakthrough," Verry said. "Parallel processors were pretty good before—"

"Hey," said Tony. "Those were *your* parallel processors. I just established the hierarchy."

"Well sure it's a new form of parallel processing," said Verry. "But it's the overall integration of parts in a whole—we couldn't have done it without you, Tony."

The chatter bugged the hell out of me. Even so, I could see Joe beginning to rise to the bait. He looked at the kid, and at Verry.

"On the tube," he said, "all you talked about was the frigging rabbit."

Tony flinched, but grinned anyway. "Well, sure, and that's what it's all about. The frigging rabbit."

Everyone laughed. I relaxed a little. Joe likewise, if a littler bit.

"Sure," said Verry. "People see the rabbit and can't believe it's real—or that it *isn't*. It's both real, and not real, in terms of being a *rabbit*."

"That's right," said Tony. "It's a machine. But how does anyone know that? You can cut it open and it bleeds! You look at its face and it looks just like a rabbit, acts like a rabbit, and moves like a rabbit. You analyze its cells and the cells work the same way the cells do in a rabbit."

"Almost," said Meg.

"Even shits like a rabbit."

"But we *made* it," said Verry. "It's all the result of electronic output."

"That's the difference," said Tony, his face alight. I have seen enthusiasm on the face of a teenager but never such brightness as came from this light-bulb of a high-school head. "We *made* it. Or even closer to the truth, we *let* it make *itself*. You have to say that. I didn't even really invent the hierarchy. We let the hierarchy establish itself. But the *brain*—that's the real thing. It takes like about four hundred of old Holland-style neural nets to make *each* neuron, and even at that, it probably isn't enough—"

"Do you still love him?" Verry said one night.

"Still love him?" I cried out involuntarily at the question and felt the pain within me that came neither of age nor disability. "How could I not! My god, Verry, he's my boy! He was every-

thing! Everything! Maybe that's how it got under my skin, and turned me into—" I stopped, unable to go on. I pulled in a breath of air I thought I could never release, for it felt strong enough to yank out my heart with my lungs.

I buried my eyes in my hands: futile gesture, in a room already dark.

I glanced over at Robert. He kept his eyes on Joe without opening his mouth. He knew Joe would back off if the boss spoke up.

Hell if I would say anything, either.

"You know what we lacked before, don't you?" said Meg, interjecting.

"Basic know-how," he said.

"No-how, Joe. Whatever we *have* at any one time—that's basic know-how. It isn't something you can ever *not* have." Meg spoke slowly yet with conviction and a steadiness, despite her partially nerveless lips, that brooked no interruption. "How can we ever *lack* what's always there? What we needed was enabling technology. You know what that is. Like the telephone. The telephone is part of the enabling technology of the computer network."

"I know about that but what about—"

"Right. The quest for the augmentation machine."

"Hey," he said, "I *didn't* say *that*—"

"But it's still on your mind and it's still on ours. A simulated human mind. That's what we want. And we still think the way to get it is by simulating the entire *human*. And we're closer. We can do it. We *can*! Tony here's our key."

I held my breath.

Tony piped in. "It *is* the arrays of parallel processors that did it, just like they might make it possible to make a real augmentation machine," he said to Joe, before Joe had a chance to recover his wits. "We needed them all because it's the *only* way of constructing working DNA for a robot."

"Not rabbit," said Verry, with a smile.

"A rabbit and a robot. But the thing is, to model the macrocosm we had to—"

The *words* this kid used! He talked to Means too much.

"But your rabbit isn't a robot!" Joe said.

"Says who?"

"Says me! What you've done is created a virtual rabbit, down to the DNA, with all your multiprocessors working like crazy to imitate what normal cells do; and it's a simulation, not a robot, because your physical here-and-now rabbit is dependent on the computational power assembled *outside* your frigging rabbit Hocus! Because even if your cells are self-reproducing and diversifying to the point of creating an apparently living being, it's still connected by an umbilical! It's still computer-dependent! What I want to do—"

He stopped.

I cannot describe the sudden sense of tension—not a tension that arose then and there, but one that vanished: for around us had been the hovering and squeezing kind of tension never known to be there until its departure.

Joe had taken the bait and *run*.

"Every tool has a handle," Robert

said to me not long after we met. Nearly a decade ago, now. "By that I mean there's an interface between us and the tool. You know what 'interface' means."

"Sure as hell do," I said, maybe more hotly than I intended. I had yet to make up my mind about this Mr. Means.

A man leaving middle age who about *bad* it with everything, I had just emerged from a part of the hospital I never imagined existing: recovery and rehab.

Not from drugs.

Recovery from violence.

Rehabilitation from who I was.

From *me*.

Robert Means worked with the Virchco outfit that produced the testing program at St. Mary's for social misfits of all stripes. They believed antisocial behavior often results from under-utilization.

People come into this world equipped with different arrays of abilities, inclinations, and talents. If they fall within the normal range, fine. If not, society may fail to *use* them.

One way to effect rehab, then: you devise radical new tests—in the case of Virchco, a V.R. system set of infinite-permutation routines. They make a stab at evaluating such elusive characteristics as imagination, flexibility, spatial perception, mental coordination, and adaptability to changing frames of reference. What else do you test for? Speed in comprehending complex situations? High thresholds of patience? Aptitude for character analysis? These, yes, and *anything* else you can think of—which sug-

gests the utter impossibility of the task.

"You know, Fred," Robert said, looking across the metal desk in the off-white room serving as his office in St. Mary's, "I came here with only the faintest hope I'd find someone useful to my own work. But here you are. And you were practically under my nose. I would never have guessed."

"I don't know what you mean," I said. "I mean, you've shown me I did OK—"

"Doing OK isn't the point," Robert said. "Anyone can do OK because we don't have any standards for what's OK and what isn't. We aren't working from some scale you have to score high on. I want the unexpected—so I guess you could say I'm looking for whatever I'm *not* looking for. I certainly wasn't looking for you."

I fidgeted. I had no idea why I should be in this office. I knew, however, that my initial resentment dissipated. I felt no anger. This interview had novelty.

Usually resentment grew—it *always* grew, no matter what I did—and turned gradually into nastiness.

It felt novel and *right* not to feel like a mean sonofabitch.

"Let me ask you this," Robert said. "And I know this goes back a ways. A lot of years back. I've checked."

I felt a hint of the knife-edge of bitterness, as if it rested against a tendon in my arm, ready to press and cut. I waited for what he would ask.

"Do you know why your parents thought you were mentally retarded?"

A red-flash of anger erupted briefly until I registered and considered and

turned over for re-examination that one word in his question: *thought*. My parents *thought* I was mentally retarded.

A thousand answers sprang into my mind. All died within me, just as suddenly. All of them, except one:

"No," I said.

"I have an idea. Want to hear it?"

I suddenly regarded the man opposite me with fear. He had transformed himself once already from an anonymous nobody good at devising gimmicks with a machine into a human being who had surprised me—startled me—by forcing me into revealing myself. I never revealed myself. *Never*. Hide is the word. Hide! Now he transformed again into a spectacled mystery who could peer into darkness. Time, and my mind: I regarded both as darknesses.

"Yes," I said even as I cried inside—*"No! No! No!"*

Part of me ran away, down the hall, out the door, out into the sunlight outside St. Mary's, screaming the whole time.

The rest of me stayed and heard out this man.

"You were delayed in a lot of things," he said. "Extremely delayed. I won't list them all. But one was speaking. You were slow about that."

Yes, I thought.

"When you finally talked, though, you did exactly as well as your peers. You fit right in. But by then you were already *with* other slow-learners." Robert spoke in an odd way, with eyes slightly held wide and a tension around the muscles of the nostrils—I notice such things—that spoke of

some kind of excitement, as though these thoughts he was expressing surprised and affected *him*, too. "And what was going on was exactly the opposite of being slow—you were tremendously *fast*. But no one knew it because you never showed it. In a way you didn't have anything to show—because it wasn't just our usual *spoken* language you were learning."

How's he know this stuff about when I was a kid?—a resistant part of myself protested.

He went on: "I don't know if you've heard about kids who grow up bilingual. It happens, sometimes, that the parents speak English and the nanny, Spanish. The parents get worried, because months pass and the kid isn't speaking yet—and time passes and passes. The kid's backwards! Then, suddenly, the kid speaks—in *two* languages. The kid can handle talking with the parents, *and* with the nanny—and the kid knows to keep the languages separate! It makes sense that the child needs more time before speaking—for it's establishing parallel but separate language systems in its head! Something like that happened with you."

"I only speak—"

"Something *like* that. What was the equivalent for you, of the other language, that you were learning? Have any idea? Any at all?"

A shake of the head from me.

"You were practically *born* with something I've worked all my professional life to acquire. We could call it the language of interface, because it consists of an entire mental vocabu-

lary and way of putting that vocabulary together. It lets you think things other people can't.

"An example of what I mean. When most people talk about a door, what do they see? They see a slab of wood, or an aluminum frame with a panel and screen, or two sheets of plywood with an air space in between. But when I say the word 'door' to you, what do you see? Do you see the wood or aluminum or anything flat and taller than it is wide? No—or at least you *didn't*. By now, you've adapted at least a little. Because I bet as a kid, because of this way you have of seeing things, when you learned what a door was, you pictured the *handle*, and maybe the hinges, and maybe the frame. Because you saw the interfaces. You saw what made the door different from the wall; and you thought that what other people saw as a door was the unimportant part."

I stared at him. My first thought: *He's right!* My second: *How's he know?* Third: *Who cares?*

"In other words, you saw that a tool isn't a tool without its handle. That's what we believe, those of us studying interface. The interface *is* the tool. The interface defines our relation to our world. The interface is *technology* whole and entire!

"It wasn't *what* you did in the Virchco tests that caught my eye, but *how* you did them. Almost everyone goes into a virtual environment and sees *things*. That limits their ability to act and make decisions. You are the *first* I've encountered to understand innately that *everything* in these tests is a *tool* that can be *used*—that what

we're doing is surrounding ourselves with every possible tool—or in other words every possible *interface*. Society is busy doing that all the time. It's what I call maximization of culture. Maxxing on the availability of tools—and *seeing* the tools."

After the initial stab of recognition in what he said, I grew nonchalant. I had no idea why he should be interested.

In three years, however, together with being engrossed in a set of training modules in computers and mathematics I *never* thought I could fathom, Means had me halfway toward seeing how to use my talents; and he had me on a project designed to mimic the way the eye perceives different shapes in motion. First I created a theoretical brain that could use a theoretical eye; next, a multiprocessor-backed real-time eye. My work had to do with how the brain makes *handles* for the images the eye takes in.

In two more years I had the pair of eyes and the set of optic nerves with appropriate software that went into Hocus, the nexus of gigabyte access and multiplex process that looked like a rabbit and bred like one when it came to expenses: eight million dollars-plus and counting.

Which was nothing.

Nothing compared to what would come next.

The rest of the party left, with a few meaningful glances toward me from those who knew, and a puzzled look from Tony, who knew no more than bits and pieces.

I gave myself over to an impulse I

hoped would be a good one:

I stepped down, walked to the door, locked it, and flipped around the *Open/Closed*, to have the former where we could see it.

We were open.

Joe said nothing, silently filling a beer for himself and looking self-absorbed, as if considering an impulse of his own.

He gave in, too.

He walked around the bar to the customer side and chose a seat a few down, so the bend in the bar separated us.

"It's fantastic what Tony's done—and he's going to keep on doing it," I said as a way of getting back on track.

"What do you mean?"

I noticed how he said these words. He meant the question for what it was: a question. He hid no resentments behind it, and no distrust. How different from a few years ago!

"I mean this project's enough to keep Tony going for years. And it's what Tony wants to do. But you know that Robert—"

"Robert. He wants the *next* thing."

"Yes!"

"He wants—"

Joe shook his head, his facial muscles fighting between a smile and a frown. His eyes glistened at the difficulty; and at seeing it I felt something I had nearly forgotten.

"Yes," I said again, fighting down my own excitement and fears.

"But hell," he burst, "it's the whole business all over again! You *know* why I got out of it and you *know* why I could never pick the project up again! My god, it's a kind of immorali-

ty, isn't it, to work on simulating an entire human system, and then rendering it into an independent entity— isn't it? Isn't it? I mean you *realize* what Tony and the whole crew—you, too—what you're doing? You're working on life itself!"

"Yes, but you—"

"Don't interrupt me! Who the *hell* do you think you *are* to do that? It isn't any game! It's that last stop of science—because you know that if we create a human analog it's no longer an isolated scientific project done for its own sake; it's a matter of acting on behalf of everyone, because in creating an electronic organism, an entire being—it changes everything! We're no longer alone! We've maybe even created our successor, our Moravian child! Once you do something like that it doesn't just go away!"

"Joe," I said. "Think about this. Put it in perspective. We *are* going to revive the project. We're going to create a simulation of a human being, along the lines we've just explored with Tony's rabbit. Self-generating systems will do most of the cell reproduction, with the DNA replaced by series of parallel processors; and, yes, it may turn out—we're even *hoping* it will turn out that we're not just creating an analog but an actual *thinking* and humanly *feeling* creature—an electronic being with a real-time model, or call it a 'manifestation' if you will, with whom we can interact in three-space, just as with Tony's Hocus. And, yes, if that happens, then—"

"But you don't get the point. You know why I quit before! We're such goddamned hubris-filled idiots that

we don't realize how deeply *flawed* we are and don't see it would be an absolute mistake to put ourselves in the position of creators!"

"We *aren't* the creators!"

Joe had avoided my eyes in his ranting—maybe because he knew I heard his objections before, or at least *knew* of them: I had joined Med-Dyne after he left, after all. Robert had filled me in pretty well on what had preoccupied him. Joe had come to hate the idea of himself being responsible for the creation of life: his own faults loomed too large.

As if they loomed any larger than anyone else's.

He met my eyes now, questioning me by silence.

"We aren't. Not at all," I said. "Look at what you believe, Joe. Do you believe in a God who made us human? I don't, and last I knew you didn't either. The Universe and its laws are the environment for emergent structures and phenomena, one of which we call life; and life itself creates sub-environments in the Universe suitable for its own propagation; in other words, life begets life."

"We're talking an entirely different order of things. We're talking potentially *intelligent* life, intelligent *electronic* life we're creating!"

"Exactly. Life begets life, and life includes intelligence, on various levels. It does! And intelligence begets—"

"But how can we *justify* it?"

"It may be an emergent quality of a technical society that we create forms of intelligence other than our own—like the form we're after, electronic intelligence. Or should I say, it's emer-

gent that we create *other* forms of electronic intelligence, since we have electronic intelligence ourselves, biologically based; and our society, made up of thinking brains, might be viewed as a complex electronic network, each of the agents of which are working in roughly parallel ways and working on some different aspect of the central question—which is, *How do we replicate ourselves?* Replicate—not as organic human beings, but as electronic intelligences?”

“It isn’t our central concern as a society!”

“Who’s to say it isn’t?” I said. “What we *intend* is different from what *emerges* from our efforts. Emergent phenomena are never the projects of intention. There’s nothing teleological about it.”

Joe looked at me suspiciously. “So you’re saying we should just go blindly into this, because it’s going to happen anyway? Because society’s pointed that way?”

“Not really. I’m saying we *do* have to take responsibility. Especially if it’s given to *us* to be the ones responsible. Look at it this way. Who’s going to be most responsible about something that *needs* responsibility? Someone who knows the difficulties? Or someone who goes into it completely blindly? Well, obviously, the one who knows the difficulties! Someone who can think about the future, maybe even someone who *fears* the future and knows to guard against what can go wrong!”

That left him silent. I wondered how far to go.

Then I wondered if I could afford to

stop before pushing the point all the way.

“I guess,” I said, “I’m also talking about us. Us, as individuals. And that other responsibility, the one to ourselves. We’re extremely particular products of society, with extremely particular abilities and talents—and *none* of us are *destined* to do *anything*—but we’re faced with a choice: do we use our talents and visions, or *don’t* we. If we *do*, we act as fully human as we can be: because we’re participating in what it is for *us*, as individuals, to be *human*. If we do, we accept responsibility! If we don’t, aren’t we rejecting—”

“Oh, man,” Joe said, burying his face in his hands, rubbing his eyes, then seeing his beer and remembering to drink. He drank it all. “Man, you’ve been around Robert *too* long.”

I laughed. “I was just thinking the same thing about Tony,” I said, or tried to, against the choking in my throat—choking, because it registered, this new change in Joe: for when he said this, he nearly *smiled*.

He *wanted* back on the project. I knew this now, with a certainty that surprised me. Robert, too, must have known.

“It gets me,” Joe said, “how you think a guy who held a gun up to his dad and then pulled the trigger could help in any way in creating a *good* electronic human.”

“Yeah,” I said, “but look who else Robert has on his project—that same dad who grew jealous of his son, got enraged that his son was finding the outlets he himself lacked—the *usefulness* that he himself lacked—

and then *beat* his own kid—beat the crap out of him! Beat him to the point the kid stole his gun—and used it!”

“Yeah,” he said, nodding. “Oh boy. Yeah.”

We sat for a while after that.

Then we stopped sitting.

We both shook with nerves, getting off the bar stools.

So damned hard, making up for years of absence in the embrace of a moment.

Nearly cracked each other's spines.

Afterwards we needed more beers, to replenish liquids.

Joe tossed me a clean countertop rag to make me stop using my sleeves.

“You’ve never told me,” I said, when I could, “who it was backed you for this joint.”

He looked around the bar, as if seeing it for the first time. “It was him, you know. Robert. Robert put up the money.”

Robert Means had put Joe where he would be forced to grapple with other human lives, while grappling with his own. A place and time enough to learn yet another language: *human* interface.

Should have guessed.

No one has cataloged all the terrors of the mind, although most of us start lists of our own.

Mine begins with memory: there I have stored myself, my actions, and my reactions to others; and there, in a museum dedicated to the prehistory to my Now, I see within a glass cabinet the visage and body of a man I have been, however much I must struggle to believe this lineage and descent;

and the man I see stands stoutly, with a grimace of surprise, and with a hand reaching to clasp his side, where the red badge of the bullet-wound spreads; and beneath him, near the glass, in neat letters, a sign reads, “*Here there be monsters.*”

To be human means to be in possession of a physical body of chemical and electrical nature over which one has partial, never complete, control, as well as a mental “body”; and it means one suffers through periods when the ability to control even the mental portion slips too easily from grasp. At such moments one can become saint or monster—for some saints are made unwillingly, just as some monsters. I know which I became, after being nurtured by neglect, by the perceived hatred of my society that turned to self-hatred, by the self-inflicted misuses of mind and, consequently, body, which I achieved by abandoning talents I deeply knew to lie within me but out of reach. I knew no function to attach to my existence; and I became monstrous. I did violence to my son, hideously, with tortures of body and psyche, raining blows by cruel hand or word. I beat him, for he became what I most hated—the image of what I should have been: a human engaged in self-building.

Human means self-maker. We require constant self-construction; otherwise self-destruction sets in. I proved it for myself by setting into motion the series of events that ended with that piece of lead burning through my flesh, near enough my spine to give me pause even now.

I pressed no charges. I offered my-

self as the criminal; and when they heard the facts, police and court agreed.

Now the two of us wounded humans are at work creating a third wounded human: for we do think, all of us, that what we create will be human; and we believe we must wound it, through blindness or insensitivity or stupidity, or all three.

How can we help it? How can we *not* be blind when we advance into the never-seen?

Yet can we let blindness stop us?

Many of the thinkers and computational modelers and systems developers upon whose work we base ours see little difference in essential nature between the process of learning within the mind, cell development, individual adaptation to environment, corporate survival, and species evolution; and specialists in *those* disciplines tell us incontrovertibly that nothing—no mind, no cell, no corporation, no species, no genus, no *system*—reaches equilibrium. All systems consist of imperfect hands reaching for what cannot be reached. Can we be any different? Would it not be an even greater form of hubris than the hubris we embrace now, if we were to sit awaiting own perfection, awaiting the time we have self-built ourselves perfectly, before daring to attempt to build another? I say it would be. It would consist of the greatest hubris of all. Robert, and the rest of the team, believe likewise. Even Joe finally sees it that way.

Do any parents await the achieve-

ment of their own perfection before trying to create the perfection of a child?

Throwing ourselves into this project: it is our way of reaching.

I still think often of my bullet wound. I must. Sometimes I feel it as if it remains a physical passage ripped through me. A perpetual wound.

I think then of Joe, whom I clearly remember turning from the wall where I had driven him; I remember seeing the glow of *knowing* in his eyes, and seeing the muzzle of my own gun. I remember it clearly: for it pointed at my heart.

I thought: *The little buzzard's going to kill me!*

Yet a moment before the flash and burn and screeching pain hit me, he carefully and steadily lowered the muzzle from my chest so the bullet struck my midriff.

Joe in his own way—I hate to put it this way, recalling as I do the aching and soul-searing *pain*—but in his own way he was engaging in Robert's practice of saving *human* lives: his, mine, and possibly someone else's, too, though he could hardly have guessed that this new life taking form beneath our hands, our gazes, our minds, is a new potential that will reach to *realize* itself, exactly as would another *human* being.

Potential, reaching to realize itself: we try to save that, wherever we can. I do. Joe does. Everyone here does.

Because we *know* where we must most firmly take hold:

Where we cannot yet reach. ■

Maya Kaathryn Bohnhoff
MARSH MALLOW

*The trouble with consultants is that they
may do exactly what you hired them to do,
instead of what you hoped they would do!*

Illustration by Steve Cavallo





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They called the planet Bog for lack of anything nicer to say about it. The name was certainly appropriate if not 100 percent accurate. The entire planet was *not* a bog, but anyone set down in its narrow "temperate zone," would find that hard to believe. The planet's abundant supply of surface water brought to mind words like "sludge" and "morass"—even "bilge." Not a drop of the stuff was drinkable. It contained salts and minerals in such concentration that, in some of the smaller bodies of water, you could float objects that would have sunk to the bottom on Earth or Pa-Loana or just about any other habitable planet Rhys Llewellyn could name.

Take that gently bobbing field lamp, for example. Rhys gazed at it in consternation as it was carried away on the sludgy currents of Brown Salt Lake, gliding serenely just out of his reach.

"See what I mean?" Roderick Halfax lobbed a flat rock at the lamp. It struck the metal casing with a muffled *ping!* and plopped into the water where it began the tedious and protracted process of sinking. A tiny cloud of native "fireflies," already visible in the twilight, eddied above the flotsam, apparently attracted by the gleam of alien metal.

"I'd rather not have demonstrated it at the expense of our field supplies," Rhys admitted, "but yes, I do see."

Rick peered at the sludgy liquid. "You could probably walk out and get it . . . but I wouldn't recommend it." He turned back from the water to make his way up the newly construct-

ed pier laid just last week by Tanaka Corp's advance team of engineers.

After a last glance at the lost field lamp, Rhys fell into step beside his assistant. "I'll bet you can build a boat out of just about anything here—wood, metal, stone—"

"Ah, but sir," Rick countered, a frown puckering his brow, "the natives here don't build boats, nor do they work wood, make metal or carve stone . . . sir."

Rhys laughed; the younger man's impersonation of his very earnest female assistant, Yoshi Umeki, was humorously accurate. And, of course, what he said was also true. The "natives" of Bog did none of those things, which posed the question of whether they were "natives" at all in the anthropological sense. There was nothing like alien/human contact to blur the lines between man and intelligent animal. Rhys could recall particular humans whose behavior blurred the lines even further. It was that sticky question of sentience that Rhys Llewellyn had been brought to Bog to answer.

"Ah, Yoshi!" He looked up and saw the girl making her way toward them through the stacks of tarp-covered trading goods and camp supplies that sat upon what passed for terra firma in this neck of the swamp. She was pecking at a notepad with one finger and frowning earnestly over the results of her work. Seeing Rhys and Rick, she paused and waved, oblivious to the admiring glances of a handful of Tanaka engineers who'd gathered around the mobile cantina.

Rhys lengthened his stride and cov-

ered the distance between them to give the girl a hearty hug. "So, Yoshi—any candidates for sentience among our Bogies?"

"Well, there appear to be several at this location." She consulted her notepad. "The top candidates are a bipedal, brachiating mammalian reminiscent of a lemur, a burrowing reptilian form not unlike an iguana, and an amphibian that builds mud lodges in the swamp."

"Ah, now *that* sounds promising."

"I'm glad you think so, Professor. Personally, I find it all rather depressing."

The voice, sporting a decidedly British accent, came from over Rhys's shoulder, making him turn. He found himself face to face with an inappropriately well-dressed man of perhaps middle age. He was average in height, bland in coloring, and wore an expression of annoyed boredom. "And you are?" Rhys asked.

Yoshi jumped into the conversation. "I'm sorry, sir—I mean, Rhys. This is Raymond Godwin. From, um, Acquisitions."

Godwin extended his hand in Rhys's direction, his eyes sweeping the younger man with urbane horror before lingering pointedly on his McCrae tartan kilt. "Director of acquisitions, this sector." His upper lip twitched minutely.

Rhys, suddenly conscious of how itchy the woolen kilt was in the marsh's thick sauna of an atmosphere, tried to make his smile sincere. "Rhys Llewellyn, acting Director of Trade and Cultural directions. Exactly what is it you hope to acquire, Mr. Godwin?"

"Mineral rights to this entire planet. And first shot at its other resources."

Rhys frowned, trying not to twitch under the combined attack of wool, perspiration, and sudden unreasoning dislike. "I don't understand. . . ."

"The advance reports on Bog came into Corporate Acquisitions just over a week ago. I was immediately dispatched to make known to the powers that be that Tanaka Corporation wishes to possess mineral rights on Bog."

"Did acquisitions also receive the advance reports on the native life-forms?"

Godwin nodded. "No signs of civilization." The idea obviously delighted him.

"No sign of civilization as we know it," Rhys cautioned. "Any of the creatures on Bog might be sentient."

Godwin shrugged. "Fine. You find the sentients, I'll negotiate for mineral rights."

Oh, so simple. "Have you ever done anything like this before?" Rhys asked, keeping his voice carefully neutral.

"Dr. Llewellyn, acquisitions is my *career*. Of course, I've done this before."

"What I meant, Mr. Godwin, is have you ever pursued an acquisition this early on—before a trade partner's even been identified? Before a language has even been determined in which the parties can negotiate?"

"No. But *you're* the expert in that department, Dr. Llewellyn. I'm counting on *you* to find the trade partners and their language." He smiled. "After all, that's what Tanaka pays you for, is it not?"

Rhys glanced sideways at Yoshi, whose expression, for once in her life, was blank. "It is. I'm merely surprised that the company is acting so precipitously."

Godwin shrugged. "Bog is a mineralogically wealthy, if miserable, planet. We surely don't want that wealth falling into someone else's pockets . . . Bristol-Benz, for example." He favored Rhys with a lopsided smile. "Frankly, I'm surprised Vladimir Zarber isn't here already, breathing down your neck."

At the mention of his arch-rival, Rhys grimaced. "Like you, Vladimir Zarber is used to working more . . . established prospects."

"Well, Professor, I'm told that establishing prospects is your forte. I'm looking forward to seeing you in action." He glanced about at the pallets of goods. "Now, I see you have a variety of merchandise. How do you plan to determine to whom it should be offered?"

"Shotgun, Mr. Godwin. We open up our little marketplace and see who shows up to shop."

"And how long do you expect this process to take?"

Rhys smiled. "Why there's no telling about that. Could take days . . . months. . . ."

"Years," murmured Yoshi.

Godwin threw her a subtly horrified glance. "You'd willingly spend that much time to determine sentience? Months in this godforsaken cow wallow?"

Yoshi's mouth twitched. "Or years," she repeated.

"That's ridiculous. Tanaka doesn't

have that kind of time to invest in such a pursuit."

"You're always free to leave," Rhys told him. "We'd gladly contact you when and if we had something positive to report."

"What, and allow Bristol-Benz to sneak in and snap up resources? I assure you, what their advance teams lack in scientific method, they make up for in expediency."

"I'd hardly allow that to happen," Rhys assured him. "I've a few negotiations to my credit as well."

"Commodities. You negotiate *commodities*. I'm talking about planetary *rights*, Professor, not trinkets." He shook his head emphatically. "No, sir. You will simply have to determine the existence or non-existence of sentient beings in a reasonable length of time. Whether I deal with those sentients or deal with the Collective, I have a charter from Tanaka to acquire the mineral rights to Bog. As depressing as this ball of mud is, that sickening stew of elements"—he gestured toward the lake—"is worth its weight in platinum. Now, if you'll excuse me?"

"What an obnoxious character!" Rick Halfax exclaimed to Godwin's receding back.

Rhys followed his gaze. "Hmm. And impatient. Well, let's see if we can't get Mr. Godwin his stew."

"Do we have to?" Yoshi was watching the acquisitions director with undisguised distaste.

Rhys glanced at her in surprise. In their several years together, he had rarely known her to express personal dislike for anyone. Yoshi reacted to causes rather than personalities and

she had obviously decided that Mr. Raymond Godwin was inimical to the cause of Bog.

The next several weeks Rhys and his colleagues spent ferrying their wares to different parts of the local marsh. Within the habitat of each of their candidates they created what they hoped were attractive displays of goods. The arboreal simians hid from them, the reptilians ignored them and the amphibians wrecked the "market-place" and incorporated the wreckage into their gloppy constructions.

"Interesting," Rhys enthused, studying a particularly elaborate mound that now sported strips of bright, human-made fabric and squares of thermoplast and metal.

"You're not actually *encouraged* by this random destruction are you?" Wearing a crisp new camouflage coverall and a small helmet, Raymond Godwin gaped at him from the midst of their decimated cache.

"There's nothing random about it. They needed material for their constructs—they took it." Rhys returned to where Yoshi waited at the cache with his field kit and began to rummage in it.

"Yes, indeed they did. They took fabric, food, tools, baubles—anything and everything—and used it indiscriminately. Surely you can't argue sentience based on that? Beavers do *that*, Pekulan treemunks do *that*, yet I doubt even *you* would attempt to open trade relations with them. . . . What *are* you doing?"

Rhys ignored him, continuing to describe a circle on the soggy forest

floor with a fluorescing powder. Within the circle, he placed a group of objects taken from the rear deck of their enclosed swamp buggy.

"Oh, I get it," Godwin said. "You're attempting to communicate, aren't you? You're trying to tell our amphibian friends that this stuff didn't get here by accident."

"Something like that," Rhys admitted. "I'm also trying to determine if they've a preference for certain materials."

Godwin glanced back across the glade to where the Bogies's mud lodges poked in misshapen domes from the water. "Shiny or bright stuff. They seem to like . . . ornamentation."

Rhys acknowledged the observation with some surprise. "Yes. The question is, is it a *cultural* affinity for ornamentation, as you call it, or is it merely an animal's attraction to shiny objects?"

Godwin seemed to show a little more interest in their mission after that and even helped set up their surveillance net. With vidcams focused on the cache and on the arm of ooze (a lagoon, technically) that poked into the glade from the marshy lake, they took their swamp buggy and withdrew to watch and wait. Before they'd gone even a handful of meters from the spot, the amphibians came ashore to explore the cache. They were bashful at first, skirting the display of goods and sipping condensation from the broad, glossy fronds of a low-growing plant—for all the world like a band of burglars trying to look nonchalant as they cased a prospective

target. When they finally moved, they ignored the bright chalk circle—except to spread it about with their flat, webbed feet—and went straight for the shiniest or most brightly colored objects they could find, carrying them back to the water in their wide mouths. Other creatures appeared as well—some large, colorful avians the size of small macaws fluttered down to pick at anything fibrous; a small mammal of some sort shuffled among the foodstuffs; a shapeless, lumpy thing like a headless, legless armadillo scuttled here and there, its only remarkable feature the irregular patches of bright color that decorated its otherwise drab hide. It trailed a cloud of the gnat-sized fireflies, recognizable in daylight only by their iridescent green wings. Everything got thoroughly pawed over, but except for the bright building materials and the food, nothing was taken. All in all, a disappointing episode.

They moved their "trade center" north after that, determined to give the bashful simians more study. The lemuresque creatures seemed to have some promising social habits. They built tree houses—or at least elaborate nests—they lived in family groups, and formed communities made up of a number of families.

"I'm actually quite hopeful," Rhys said when they'd completed setting up shop in the fringes of one of the arboreal "villages." "They exhibit a number of distinguishing social characteristics that could indicate sentience."

"Doesn't the mere fact that they build those little tree-houses mean they're sentient?" asked Godwin.

"That makes them tool-users, doesn't it?"

"There are any number of animals that weave nests at least that elaborate," said Rhys. "That doesn't mean they're people."

"What would make you consider them . . . people?"

"Observing trade would incline me to hopefulness. As would the use of a discernible language—or some other system of observable communication."

"Ah . . . the operative term being 'system.'"

Rhys nodded. "Another bit of evidence might be the cultivation of food or the domestication of animals."

Yoshi, peering at the monitor, glanced up. "You mean like the birds? They seem to be all over the village here. And what about those big arthropods?"

Rhys, Rick and Godwin all moved to look over her shoulder at the large flat display. In the clearing central to the simians' tree-houses, several of the lumpy, waddling creatures milled like legless, armored sheep. The simians sat peacefully among them, feeding on the seed-cones of the lacy coniferous trees, tossing the used-up cores at the native "armadillos" which snuffled up whatever the swift avians didn't nab, occasionally using some well-concealed body part to fling one back toward its point of origin.

Yoshi chewed her lip. "Pets? Livestock?"

Rhys nodded. "Could be. Could also be simple scavenging. Only time will tell."

They watched their cache of goods

with great anticipation, but the simians' interaction, when it came, had more in common with pillaging than with shopping. Accordingly, Rhys took the next step. Over a period of days, they moved their observation station closer to the village perimeter, insinuating themselves into the landscape. When the simians no longer ran squealing for the trees the moment the humans twitched a toe, they staged what Raymond Godwin snidely referred to as their "inane little skits." Rhys and Rick went through the motions of trade, playing merchant and customer, making a performance of the exchange of goods. Their performances drew a furry crowd of onlookers; the lemuresque creatures became bolder, even going so far as to touch some of the wares displayed behind each actor.

During the third or fourth skit came the breakthrough that Rhys had been hoping for; one of the simians picked up a piece of off-world fruit and made an attempt to interest one of his comrades in it. In a matter of minutes the creatures were picking up food and playing at exchange. Eventually, the trade broadened to include sticks, rocks, seed pods from the trees, anything they could find. Some courageous individuals even offered pilfered foodstuffs to the humans. But Rhys Llewellyn watched with increasing disappointment; there was no method to the madness, no pattern. The simians weren't trading, they were merely mimicking observed behavior. Even as he looked on, still searching for signs that the Bogies comprehended their actions, they be-

gan flinging stuff about and the "trading" degenerated into a food fight. The humans withdrew.

"I don't think they get it," Godwin said. "Pet armadillos or no, I think they're animals, not people."

"Give it some time, Godwin," Rhys told him, trying to be optimistic. But the next day's trade went no better. Upon seeing the humans, the simians began to caper and playfully exchange random items, which were forgotten as soon as they left the traders' handlike paws. As before, the episode ended in a hail of badly aimed projectiles which pelted humans, simians and their "pets" indiscriminately.

Rhys's only reason for hopefulness was that the simians were observed to sip water from the same broadleaf fronds he'd seen growing in the lake environs. Since the fronds didn't grow near the tree village, he could only suppose that meant the simians had transported them. But observing that more advanced behavior was denied the humans. The simians were never seen retrieving the fronds, they simply seemed to appear during the night. How, even Yoshi's nocturnal video records failed to show.

Rhys was disappointed. "I suppose," he told Rick and Yoshi, "that we ought to pick a new target and start again." He shook his head. "I would have bet credits that the presence of both birds and arthropods indicated nascent domestication. Evidently, it only indicated a symbiosis."

Yoshi nodded. "The lemurs leave refuse and the—the bogdillos and birds scavenge it."

"Bogdillos?" Rick repeated.

Yoshi shrugged and glanced at her notes. "I get tired of saying 'arthropods.' There are some reptiles at a site about fifteen clicks from here that have been observed in a bipedal stance. It seems they also use sticks to pry food out of crevasses between rocks and have been observed carrying articles about what the advance team described as a village."

"We'll visit them tomorrow then," Rhys said absently.

"You seem unhappy, professor," Raymond Godwin observed.

"Unhappy?" Rhys shook his head. "No. A bit disappointed, perhaps."

"Whatever for? Surely if you find no sentient beings on Bog it makes your job just that much easier . . . and your departure that much sooner." He glanced around at the explosion of damp foliage that surrounded them, every leaf and stalk glistening with Bog's dank perspiration. "I've never in my life been anyplace that sweats like this. My hair clings to my head, my clothing clings to my body. It makes Florida seem positively arid. I don't know how you can stand it." He gave Rhys's kilt a disparaging glance. "I'll certainly be glad to leave."

"I will admit," Rhys told him, "that Bog's temperate zone seems to be poorly named, but . . . I would like to have found some new neighbors to talk to."

"Well, speaking on behalf of Tanaka, whose interests you also claim to serve, new neighbors are a pain. They require the expenditure of time and energy which would be more profitably spent in negotiating with the

Collective for planetary resources. There are probably hundreds or even thousands of candidates for sentence planetwide. While your people interview every one of them, the mineral resources of Bog lie here untapped. If you find no one, you've spent months or even years doing it, only to find that Bog has no masters and the minerals might have been at our disposal all along. If you *do* find someone, then time and energy must be put into learning their language, studying their culture, understanding their point of view—and *still* the resources of Bog lie there untapped. I'm sure you can see that the best case scenario as far as our employer is concerned is for Bog to be completely without sentient life."

He had stopped just short of suggesting that Rhys come to that conclusion regardless of the circumstances. Rhys wondered if the thought had been in mind. He glanced forward to where Yoshi sat beside Rick in the front passenger seat of the buggy. Even in profile, he could see that her brow was knit and her jaw clenched mutinously. In the four years or so he had known her, Rhys had seen a thousand expressions cross Yoshi Umeki's face. He had never seen this one.

"Have you an alternative to suggest that will not contravene Collective law?" he asked carefully.

"It seems to me we might simply set up our mining operations—in a way calculated to make a minimum impact on the ecosystem, of course—and then if, in later years, a sentient species makes itself known, we can deal with it as necessary."

Yoshi snorted. "That's what they said about the Aborigines."

Godwin glanced at her, eyebrows raised. "Excuse me?"

She spoke without turning to face him. "That's what every conqueror has said about every conquered people since the dawn of human civilization—'we'll deal with them as necessary.' Usually, the native peoples end up with their culture destroyed and their numbers seriously depleted."

"My dear girl," said Godwin dryly, "we are not barbarians who have failed to learn from our own history. Rest assured, should any intelligence rear its unlikely head on this sodden ball of earth, Tanaka Corp will honor both its culture and its physical well-being. You know Danetta Price better than I do, but whatever her merits or demerits as a CEO, she is not known for a conquistadorial attitude. But there are resources here—" He broke off, turning to address his argument to Rhys. "There are, for example, significant quantities of a *natural* organometallic in the water at this latitude that has *tremendous* potential. A *natural* organometallic. And then there are the ores—did you know that there are caves about 200 clicks south of here that contain incredibly pure deposits of copper? And the surface water—all of it—contains an alchemist's laboratory stew of minerals."

His eyes gleamed. A zealot. Rhys smiled. He recognized the look. He'd seen it often enough on Yoshi's face, on Rick's . . . in the mirror. Godwin might have been him describing an assemblage of objects dug out of some-

one's two-thousand-year-old refuse bin or burial mound. And, little as he liked to admit it, there was controversy over the ethics of making use of *those* resources too.

The reptiles lived in an area that was as close to a desert as was likely to be found on Bog. The soil was sandy, merely damp, and sparsely foliated (at least more sparsely than 75 percent of Bog). In cleared areas the reptilians had built structures not unlike the giant termite mounds of Earthen Africa, pasting them together with clay from the bottom of small, stagnant red pools that dotted the landscape. Taken together with the jewel-bright green of the mounds' inhabitants, the whole area looked as if Santa's interstellar sleigh had jettisoned a cargo of Christmas ornaments.

From the cover afforded them by a tufted dune, the humans watched the activity around the mounds. Rhys was just puzzling over a group of empty and collapsed "huts" to the north of the inhabited group when Yoshi jiggled his elbow.

"Look, sir. Tool-use."

He nodded, watching a pair of the iguana-like creatures poking about a rotting tree stump with a stick. Another teetered across the clearing on his hind legs, his arms full of water-smoothed rocks. These he deposited next to one of the mounds in a heap, shoving away one of the ubiquitous "bogdillos" which had come along to snuffle at the collection. When the creature failed to move away, the reptile chittered at it, finally picking up

one of the rocks and dealing the arthropod a sharp *thwack!* A second reptile scurried over to snag the rock and skitter away with it, eventually pressing it into the wall of a mound.

"Now *there's* human behavior," said Rick.

"That too," Yoshi pointed to where a clutch of immature reptiles were attempting to feed one of the bogdillos a large, decimated leaf. The animal seemed completely uninterested which, in turn, caused the "children" to lose interest in it. They next offered their wizened frond to a flock of avians with more success.

Godwin, checking the soles of his boots for unmentionables, said, "Well, doctor. I'll bet you're just in seventh heaven. There's more humanoid behavior going on out there than I've seen in most spaceport cantinas. Shall we make an appearance and ask to be taken to their leader?"

"Perhaps," Rhys told him, "if we can determine who that leader is."

They watched the reptiles for three days without making a single move. In that time, they collected a plethora of data on community life and interaction; noted the hierarchy among the "lizards," and chased away nosy arthropods and avians. On day three, Godwin, whose patience was apparently not a virtue that got much exercise, returned to the base camp complaining of sand fleas and insomnia. The sands around their mobile cabin made a peculiar sucking noise at night which Godwin found unbearable. Rhys silently (and guiltily) thanked the sands.

Their observations did indeed yield

the identification of a dominant member of the reptile community. It was a female, judging from physiological and behavioral cues, who ruled the reptile roost. It was to this noble creature that Rhys at last decided to make himself known.

At first he merely let them see him at the edge of the village laying out his "merchandise" and making observations to his notepad. After a while he moved in closer. The reptiles watched him with their golden, saucer-round eyes, occasionally opening and closing their wide mouths; Rhys expected to hear the clack of castanets. The elder female watched him most carefully as she went about her business, which consisted largely of scolding the younger members of her group who brought her food and occasionally rocks for her mound.

By the time he was face to face with the matriarch, she accepted him without tremor or outrage, merely observing his every move through her extraordinary eyes. He proffered her a piece of glazed azure tile. She looked at it, reached out a sealy digit and touched it, then scratched her neck. He rose and pressed the tile into the earthen wall of the mound she basked beside; she watched him with vague interest. Carefully, he took a rock from the pile her young cohorts had brought her and placed it among his wares; she blinked and scratched her neck again.

He repeated the exercise a few more times, drawing a small crowd of the reptilian Bogies. Finally, one of the creatures came forward and gingerly poked at another piece of tile. Rhys



held his breath, affording a quick glance over his shoulder to where Yoshi and Rick observed and recorded the goings-on. The reptile handled the tile, turning it this way and that so the bright, glazed surface caught the sun, then he picked it up in one long-fingered hand and scuttled away with it to place it in his own pile of building materials some yards away. He did not return with an offering.

Rhys let out a long breath and tried not to let his hope go with it. But twenty or so pilfered tiles later, he admitted momentary defeat and retired to the camp.

"It seems," he sighed some days later with no further progress to show, "that all we've accomplished is to leave our reptilian friends with gaudier houses."

"Houses they may not even live in that much longer," Yoshi added. "I explored the other side of that little knoll." She indicated a nearby hillock covered with sand and some wispy bushes. "It seems that what these fellows do is build up their little mud igloos until the inner passages are all clogged with rocks and bits of wood, or the roofs cave in. From what I can tell, they just abandon the villages little by little and start new mounds right next door."

Rhys nodded. "Which explains the trail of mud huts we followed to get here."

"Professor. . . ." Rick was watching a playback of Rhys's interaction with the reptiles. "This is probably irrelevant, but does it seem to anyone else that those mud huts bear a more than passing resemblance to Yoshi's bogdillos?"

Both Yoshi and Rhys brought their attention to the video. "Roddy's right," Rhys murmured thoughtfully. "Although that could just as easily be by accident as by design."

Rick selected another time index, presenting them with a view of their encounter with the lake dwellers. It escaped no one that the water-bound lodges of the amphibians, with their anarchic polka-dots of bright stuff looked much like submerged bogdillos.

Rhys exhaled explosively. "Worship? Art? Coincidence?"

"Do we stick around or move on?" Rick asked.

"I guess we'd best move on," Rhys decided. "But we'll be back. Maybe I just need some fresh ideas."

Raymond Godwin greeted their return to base camp with ill-concealed relief. "No luck, eh? Will you be giving up then?"

"Yes," Rhys said mildly, "we're going to move the base camp to the next location."

Godwin grimaced. "And may I ask how many 'locations' there are?"

"About a dozen, all told. The habitable zone on Bog is rather small, after all."

"A dozen." Godwin glanced from Rhys to his two assistants. "And I suppose you're going to check out every one of them, aren't you?"

Rhys smiled. "Until we find sentience or determine it's not to be found. That's our job this time out."

"Professor Llewellyn, you obviously have very little business acumen. I don't know how you managed to impress Ms. Price as a negotiator." God-

win turned on his heel, narrowly avoiding doing the splits on the ever-soggy turf, and made a most dignified exit.

Putting Godwin's ill-temper out of his mind, Rhys visited the logistics chief next to arrange for the camp move. Unlike Raymond Godwin, Chief Pinski was thrilled with the prospect of some action. "My people have been going stir crazy," he told Rhys. "While you folks're out doing the jungle, all they've got to do is read and play VR games. You want to see how bored people can get?" He beckoned Rhys to the door of his portable office and nodded toward the cargo area where a quartet of bright blue, tarp-covered pallets stood awaiting dispersal. At the edge of the area, a handful of men and women in varicolored coveralls lobbed the local version of pine cones into the forest.

"What are they aiming at?" Rhys asked.

"Oh, anything and everything. Leaves, seed cones on stumps, the blossoms on those big, droopy trees, the critters that skulk around the edge of camp."

Rhys smiled wanly. "I see. Well, do you think you could ask them not to target anything that moves? I'd hate to annoy the neighbors."

Pinski chuckled. "I see your point. Sure, Doc. Now, when would you like to bug out?"

"Tomorrow morning will do fine. I'll have the coordinates for you by supper time."

Leaving Pinski's office he heard a rousing cheer go up along the edge of the cargo dump. He sighed, praying

the site crew hadn't hit anyone who would hold a grudge.

They were up by Bog's green early light. Forest denizens strove to outdo each other in song, and a legitimately cool breeze rustled the rampant foliage. Rhys took his morning shower—essential to starting a day on Bog—and realized he couldn't face putting on his kilt. The humid atmosphere made the wool itch and cling, and he was damn tired of smelling like a wet sheep. Nattily attired in a jumpsuit of jungle green, he was walking cross-camp when Yoshi fell into step with him.

"Good morning, sir," she said.

"Yoshi, how long have we been working together?"

"Four years, three-and-one-half months," she said as if she'd been calculating that very thing the moment he'd asked.

"And during those four years, three-and-one-half months, how many times do you suppose you've agreed to stop calling me 'sir'?"

She gave him a sheepish look from beneath the black silk that fell across her forehead. "Oops. Sorry, Rhys. Sometimes it just slips out. Blame it on my family—small town, Shinto-Buddhist-Bahá'í values. Every time I forget to use a term of respect for an elder or a teacher, I see my aunt Mineko shaking her finger at me and saying, 'Yoshiko, *honor* those to whom honor is due.'"

"Godwin's an elder; you never call *him* 'sir.'"

She glanced at him out of the corner of eyes that somehow blended

contrition and impishness. "Your point being?"

"My point being that after four years—"

"And three-and-one-half months," she added, and smiled. "I'm trying, but old habits die hard, and sometimes you're such a curmudgeon—"

Rhys snorted. "Curmudgeon, your Aunt Mineko!" They'd come to the mess tent and he'd pulled back the waterproof cowl over the door when he heard someone shouting for him. He turned. Rick Halfax was hurrying toward them from the direction they'd just come, waving his arms.

"You aren't going to believe this!" he panted when he reached them. "Something . . . I mean *someone* left us a pile of goodies during the night."

It was indeed a "pile of goodies." The jumble of rocks, flowers and conifer seed-cones had been left between a pair of tarp-covered pallets at the eastern fringe of their supply yard. The rocks formed the bottom-most layer; the Bogish "pine cones" tumbled atop those; the flowers were sprinkled over all like brown sugar on oatmeal. Some of the Tanaka site crew were standing nearby looking on with mild interest. A young woman pointed at the heap of stuff and said, "This is just the way we found it, Professor. We haven't touched a thing."

Rhys knelt by the knee-high mound and picked up one of the large, purplish blossoms. "Interesting," he murmured. "All of the same variety."

"The botany team was really interested in those," the young woman told him and smiled. "I think the fragrance was a hit."

Rhys nodded. "There's a lot of money in perfume on just about any world."

"Mimicry?" The one word question came from Rick, who was sampling one of the rocks with a field scanner. "They've seen us pile stuff up like this. Maybe they're just aping us."

Rhys shook his head. "Possibly, but the young lady is right—these flowers are ones the botany team was particularly interested in." He sniffed at the bloom. "Tantalizing. They collected scores of them."

"And you think one of the native species noticed that?"

In answer, Rhys nodded at the rock in Rick's hand. "What've you got there?"

"Ore-bearing. Barium. . . ." He gestured at another, lighter-colored specimen on the ground at his feet. "Gold. Also heavily sampled by the advance team."

Yoshi nudged a seed-cone with her toe. "Dr. Gallioni says these are a storehouse of natural antibiotics. . . . I guess we've been noticed."

"Hmmm." Rhys was examining the spongy ground around the cache, looking for tracks. "But by whom?"

"Oh, dear God, it's true." Raymond Godwin stood at the corner of the nearest pallet, looking aghast at the collection of native wares. "Someone or something has actually made an overture. And I thought this was going to be a simple matter of a corporate claim. Well, which one of our lovely natives left this little offering?"

Rhys turned one of the native plants in his hands, feeling a heady wash of exhilaration. "I don't know,

Mr. Godwin, but I intend to find out."

"I take it this means our move is canceled."

Rhys nodded absently, already pondering his next step.

It was easy enough to talk about finding the would-be traders, harder to do. After a long night of sleepless reflection, Rhys still hadn't decided where to begin or what he could do that he hadn't already done to flush Bog's sentients out of the swamp. He reviewed behaviors—leaf sipping, rock carrying, tree-house building . . . icon making? Any and all could be significant.

He rose the next morning, showered, dressed and literally flipped a coin. The ancient British ha'penny came up "heads," and Rhys took his crew off to the reptile village. Three days later, he was ready to give up. Aside from building houses that possibly paid tribute to the bogdillo, the reptiles showed no sign of abstract thought.

"Perhaps," Yoshi said the morning they moved their remote camp to the arboreal village, "we're not going about this the right way."

Rick Halfax snorted. "Obviously not."

Yoshi ignored him. "I mean, maybe there's some sort of protocol we're missing."

Rhys raised his tired eyes to her face. "I'm all ears."

"Well, they brought their goods to our camp and left them where we'd be sure to find them."

"Which is precisely what we've been doing. For all we know this could just be a case of mimicry."

"Or," Yoshi continued, "it could be a step in some sort of trading ritual. Like the Pa-Kai dances or the Garulin processions."

She had his attention now and he waved her on.

"We left our goods at their doors—"

"Whose doors?" Rick asked. "We left our goods at *several* doors."

Yoshi nudged him aside with a pre-emptory flick of her fingers. "I don't know yet, but what if they took that as the first step in the protocol? A bid to establish the trading ground, let's say. To them, what we're saying is, 'We elect your village to be the trading ground.' So they take the next step; they elect *our* 'village.' Now we've put the ball back in their bailiwick. But maybe that's not the polite thing to do, maybe we're supposed to accept their offer to let us host the trading."

"So you're suggesting we lay our goods out where we picked theirs up—in the middle of the supply dump?"

Yoshi nodded. "We make a gesture of accepting the goods they brought and place our own on the exact spot where they were delivered."

Rhys glanced at Rick, whose nose was buried in his coffee mug. "What do you think, Roddy?"

The other man shrugged. "I say anything's worth a try. If we can't prove any of the Bogies are sentient, this planet is going to become a big, soupy rock quarry." He leaned closer to Rhys across the table and lowered his voice. "I've seen the geological reports Godwin's been salivating over. There are so many rare-elsewhere min-

erals in the so-called 'crust' of this mudball that there's virtually no place you can dig that you won't unearth something marketable. And if you don't think Godwin would cheerfully tear up every tree, siphon off every drop of standing water and dispossess every native lifeform to get it—"

"Danetta would never allow that," Rhys protested. "And she's in the driver's seat at Tanaka."

Rick gave him a wry glance. "Come on, professor. You know big business better than that. Even Danetta Price has to listen to the board of directors. And the board of directors listens to the shareholders and a lot of shareholders listen to the siren song of the almighty credit."

"You're right," Rhys admitted, guiltily recalling that they, too, worked for Tanaka. "And Godwin's been singing that song since we met him. He has a vested interest in our failure because our success would mean a substantial investment of time. And Tanaka Corp has traditionally favored investing financial resources over investing time. Whatever we determine about the lifeforms on Bog, we've got to be damn certain."

They pursued Yoshi's idea, making a studied ritual out of accepting the native collection of goods and replacing the stash with one of their own. Then they settled down to watch. When no one and nothing put in an appearance by nightfall, they turned in for the evening and turned on the brace of monitoring vidicams around the site.

The pile of goodies was still there in the weak morning light. But some-

thing else was missing. All four of the stockpiles near the cache had been relieved of their bright blue coverings.

While Pinski had his crew replaced the tarps with extras from their shuttle's supplies, Rhys and company checked the recordings. It had been a foggy night, which is to say a normal one, and shapeless wings of mist trailed across the camera eye or rolled along the ground. Rhys began to realize that virtually anything could be concealed in that.

"What's that?" Rick asked, pointing a finger to what looked like a field of tiny stars in a slowly swirling nebula. "Fireflies?"

Rhys squinted at them. "Or the local equivalent. We've seen them before."

"Sure. Over the bog. Never in camp."

"They may travel at night. They're certainly not our traders."

Rick grinned. "Oh, I don't know. Maybe if a whole bunch of them teamed up. . . ."

Rhys gave him a mock-severe glare. "I suppose you'd like your signature to be on the report that identifies a local insect as the species Tanaka has to do business with?"

Rick turned his attention back to the monitor screen. "Not a chance."

"Not a chance" pretty much described their attempt to ferret any new visual evidence out of the video. There was darkness, fog, more darkness and a flotilla of brightly-lit insects. Rick hit on the idea of turning off the picture and focusing on the sound. That yielded little more—only the sound of plastic clips being

sprung and tarpaulins being tugged from their mounts and dragged away through the primordial ooze.

There was nothing for it but to attempt tracking the missing tarps. Under normal circumstances, following a drag trail would have been a simple task, but Bog's springy soil and general sogginess made it a hit or miss game. There was nothing like a discernible spoor, but only broken fern fronds and irregularly depressed patches of earth. They found the trail; they lost it; they found it again. Then they found a place where it appeared to fork.

"It looks like they split up," Rick observed. "One tarp was dragged off that way,"—he pointed northeast—"another toward the lake. And from the look of that—" He broke off to examine a third swathe of disturbed ground and foliage. "Two toward the eastern plateau."

Rhys straightened from his own perusal of the trails. "Roughly, one deeper into the forest, one toward the amphibian population and two toward the reptile village."

"Coincidence?" asked Yoshi.

"Let's find out. The simian tree-houses are closest. Let's try that direction first." Rhys led on, following the on-again, off-again trail until they came within sight of the nearest tree village. He was scanning the foliage above and before when Rick gave a shout.

"Pay dirt!"

Rhys, Yoshi, and the several members of the site crew who had joined them, hurried in the direction of his voice. He had found one of the miss-

ing tarpaulins snagged over a small sapling and a couple of ferns. A handful of small avians bathed themselves in the water that had pooled in its draped folds.

One of the site crew made a move to reclaim the tarp; the birds fled, chittering. Rhys put a hand up to stop the man. "Leave it. They paid for it, after all."

"But it's just sitting here, gathering water."

Rhys dabbled a finger in the pool vacated by the birds, then glanced toward the village where a group of the simian inhabitants watched with mild interest. "Indeed. Yoshi . . . set up a monitor pack to take in the tarp and its immediate area. Then we'll be on to the next site."

"Why bother, Doc?" Rick asked. "Doesn't this pretty much prove that the simians are our sentients?"

"There are two other trails to follow, Roddy. Trails that may lead to other conclusions entirely."

They took a couple of swamp buggies to the reptile colony next. Both of the missing tarps were located with ease sheerly by contrast to the earth-toned surroundings. Like the first one, these had been draped in deceptive abandon over protruding objects so that fresh water from the humid atmosphere pooled in the low points. They found the first of the two roughly two-thirds of the way between their base camp and the reptile colony. The other was just outside the village at which Rhys had attempted to barter some time before. And this one was in use—a group of the reptilians were gathered about it sipping in turns

from the vivid puddles while one or two avian friends showered beneath drops of spillage. Rhys took notes, Yoshi made a video record, then they continued to the third site.

It took longer to find the fourth tarp. Blazing blue notwithstanding, the lush colors and foliage around the lake made spotting difficult. But spot it they did, near sunset. Once again it appeared to have been set up to collect fresh water. The five person team from the site crew took their buggy and returned to camp immediately, having no particular desire to bivouac in a true swamp overnight. Rhys hardly noticed their absence. Nor did he particularly notice the presence of Raymond Godwin, who, realizing the importance of recent events, thought it in his best interests to stay close by.

By the time Rhys and his cohorts had set up camp, the rude water collection system had been in use several times by both amphibians and avians. Review of the monitor packs Yoshi had set up at the other tarpaulin sites showed similar use by both simians and reptiles.

"Are they *all* sentient?" asked Godwin irritably as they sat in the twilight and watched the activity over the lake. "Have we stumbled onto some sort of . . . of alien co-op?"

Rhys, watching the movements of aquatic life in and around one of the waterlogged lodges, shook his head absently. "So it would seem. Damn! They communicate with each other—how do we get them to communicate with us?" Rhys fell silent, gazing out over the lake as the alien

sun pulled in its green-tinted skirts, plunging the swampy glade into sudden dim twilight. He reached for a camp-light. Yoshi's hand fell on his arm, sending an inexplicable army of goosebumps marching up and down its length.

"Rhys, look at this."

"This" proved to be billows of the tiny Bogian fireflies that, though nearly invisible by day were anything but at dusk. It was as if someone had released a cloud of willful sparks; the fireflies danced over the face of the thick water and the water's surface gleamed in reply. It was a rare and remarkable sight. The mass of insects was so bright, the camp-light seemed superfluous.

Rhys, unable to withdraw his arm, glanced at Yoshi's face in the spectral glow. Her eyes were bright mirrors of wonder. His, suddenly captive, watched the glow of alien fire in them. "Bioluminescents," she murmured, "never cease to amaze me. I've never seen so many all in one place."

"Oh, and here come a few more," said Godwin dryly.

A few more was a gross understatement. A small, compact fleet of the fireflies was flitting through the tall grasses and ferns that bordered the lake. They moved at a leisurely pace, taking time to spiral skyward now and again before coalescing into a puff of green-gold brightness.

"That's odd. . . ."

Yoshi's sudden tension broke the odd spell that had momentarily held Rhys in thrall. As the hand that had lain across his forearm went to her

field scanner, he blinked and followed her gaze. Below the cloud of approaching fireflies, the grasses waved and bobbed as if the beating of those tiny wings was creating a massive downdraft. At the water's edge, no more than thirty feet from where the humans sat, the reeds parted.

"Huh!" snorted Rick. "Mystery solved. I didn't think those little sprites could create that much commotion."

Yoshi nodded, watching as two bogdillos slid into the water, their escort of fireflies commingling with the brilliant mist that hovered over the lake. "I forgot they were parasites."

Rhys stared at the bright water. "Parasites? Or pets?"

"What?"

Rhys was on his feet, keeping his voice low with an effort. "What was the one thing we *did* see on the security monitor the night the tarps were taken?"

Yoshi had risen too. "Fireflies."

"And what do fireflies have in common with every one of our potentially sentient species?"

Yoshi's brow knit. "Bogdillos?"

"*Bogdillos?*" Rick repeated. "But they're scavengers. They sponge off everybody. They even horn in on the houses the amphibians build."

"They've got symbiotic relationships with not just one other species," argued Rhys, making emphatic gestures with both hands, "but with three or more. They get fed, petted, and scratched—"

"And in return," said Godwin, "they provide house plans?"

"No. They provide *water*!"

"Water?" echoed Rick. "I don't—"

"Remember the broadleaf plants we couldn't account for near the simian village? Good God, they were all over the ground in the reptile colony too, I only just realized. What if those are the bogdillo's attempts to provide water to the other species? We came into town with a better system of trapping water, and the bogdillos—having observed what *we* found interesting—traded some of it for what *they* found interesting. Namely, big, blue 'leaves' that could be used to trap precious water in larger quantities."

"They're a diurnal species," added Yoshi, "yet they have adapted to nocturnal activity by—possibly—harnessing another lifeform to provide light."

"And just how do you propose to prove this marvelous construct?" Godwin asked, blinking up at them through the eerie faux-twilight. "We've heard not murmur one from those bug-dillos of yours."

"That doesn't mean anything," Rick objected. "They could communicate via species-specific telepathy for all we know."

"We'll offer further trade," said Rhys decisively.

Bearing another tarpaulin along with plant and mineral samples Tanaka had found most interesting, Rhys and Rick approached the shore of Brown Salt Lake. Yoshi monitored while Godwin stood by like bored royalty. With Rick behind him holding a tarp, Rhys hunkered at the water's edge and smacked the surface lightly with the flat of his hand. He repeated this several times, then paused and

glanced back over his shoulder to where he could see Yoshi with her vidicam. She was nodding.

"They're there. Just out beyond that near lodge."

Glancing to where Yoshi had directed, Rhys could see them too, looking like nothing so much as a clump of giant chocolate marshmallows bobbing in a cup of hot cocoa.

And there, for all of Rhys's ministrations, they stayed. He had Rick wave the tarp. He laid out the samples of the goods the bogdillos (presumably) had brought them, trying to demonstrate that he would trade one thing for the other. He even left the tarpaulin on the shore and retreated. The marshmallows stayed right where they were, bobbing beneath their radiant canopy.

"I think," said Godwin, "that I am going to run, screaming, into the jungle. How *do* you manage to have so bloody much patience? If I didn't know better, I'd think you were all brain-addled." He snorted. "Hell, I'm not sure I *do* know better. *Are* you all brain-addled?"

"I was beginning to wonder myself," yawned Rick, gazing at the motionless dumplings.

"They're waiting for something," murmured Yoshi. "I can *feel* it."

"Oh, now *that's* scientific!" Godwin got up and went out to the shore to stare at the flotilla of bogdillos. "I say," he addressed them. "Are you in the mood for a spot of tea? Eh? How about some anchovy wine or something equally tasty?" He bent over then, and before Rhys could guess his intention, he had tossed a rock out

into the water. It landed with a squishy *smack!* right in front of his alien audience. They dispersed immediately.

Rhys was on his feet in an instant. "Godwin! What the hell do you think you're doing?"

The other man turned on him, face red with frustration. "Trying to communicate."

"Communicate? You frightened them away!"

"At least, *my* way got *some* result."

Rhys took a step toward the other man forcing him to withdraw to the other side of the swamp buggy.

Twilight lingered for perhaps an hour. True darkness fell. Now no fireflies brightened the lake's murky surface, no bogdillos plowed through the waist-high reeds. Rhys was thoroughly depressed and disgusted, convinced Godwin had ruined their chances of communicating with the Bogian denizens. He was sitting in the stygian darkness between an equally glum Yoshi and a dozing Rick when something thudded to the ground just out of reach. Startled, he leapt to this feet and reached for a palm torch, flipping on the diffuse beam. Yoshi echoed both movements, adding her light to his. Barely an arm's length from where they had sat was a rock.

"Are they attacking?" Yoshi whispered.

"I don't know. Kill your beam." He matched action to word, flicking off his own torch and plunging them into darkness. When nothing else happened, he stepped to where the rock had fallen and knelt to examine it, switching on his torch again to do so.

Almost immediately, a second object plopped to earth another three feet or so ahead of him. As he rose to find it with his eyes, the entire lagoon was lit up like the Christmas trees of yore.

Rhys extinguished his torch. The alien insects went dark a heartbeat later. He felt Yoshi at his side and gave her a quick glance before stepping to the second projectile. It proved to be a large, soggy seed-pod of some sort.

"Your torch," Yoshi whispered.

He turned it on. The fireflies blazed in reply. Another missile fell midway between Rhys and the shoreline. He heard a soft exclamation from behind him, and realized Rick was awake. A fraction of his mind wondered what Godwin was doing just about now. He stepped to the next marker without turning off his torch.

Yoshi flicked hers on as well. "I'll get the goods." She was gone for a moment, during which time Rhys responded to another invitation to come closer. He was now a mere foot from the waterline and could see the lumpy shapes of the bogdillos out in the water. He waited, but they came no closer. When a full minute had elapsed, he bent, picked up the rock at his feet and tossed it out into the little lagoon, so that it fell midway between shore and watchers. After a moment of hesitation the bogdillos drew closer, moving as one.

Rhys felt a chill sail up his spine. There was a moment in every first contact Rhys had known when he wondered if the other party would suddenly prove to be fanatically carnivorous xenophobes. In this case, the possibility presented itself that the

bogdillos viewed the visiting humans as a potential addition to their petting zoo. He cursed the forefathers of science fiction, chased the ridiculous thought away, and tossed out another rock, this time bringing the arthropods to just over a yard from where he stood. Signaling Yoshi to attend him, he squatted on the shore and began playing charades. He showed the bogdillos the tarpaulin, describing it ("tarp") in case they could hear him, and demonstrating with a flask of water that he understood what they used it for. Then he displayed the several most valuable of the items they had left in the base camp cargo dump, and lastly, laid the tarpaulin on the shore and stepped back.

During the brief wait, he was witness to what he could only call a conversation between the various members of the bogdillian group. There were dolphin-like squeaks, watery gargling sounds, a gamut of muted tones, and tiny, rhythmic slapping patterns executed with a foot or tentacle (he couldn't see which) upon the stiff surface of the water. Most incredibly of all, the fireflies dancing above each bogdillo—for he could now see that each entity had its separate tribe—winked on and off and subtly altered color and direction during the exchange.

"My God." The exclamation was in starchily accented English. Raymond Godwin had come down to the shore to watch.

"Don't you dare," growled Rhys, "throw anything."

"Wouldn't think of it."

The bogdillos had obviously come

to some sort of decision, for some of their number dispersed, some withdrawing to the shore and into the tall grasses, others disappearing into the amphibian lodges, still others seeming to dive beneath the water—an amazing feat considering its native buoyancy. Two of the remaining individuals glided right to Rhys's feet and emerged to face him. After each had appraised him via a trio of eyestalks, they proceeded to handle the tarpaulin with what appeared to be fins . . . or tentacles . . . or flabby pincers, depending on the use to which they were put—lifting, poking or pulling.

Rhys sucked in a long awful breath. Now, *that* was adaptability. Even so, he noticed that one of the bogdillos was having a little trouble folding back a corner of the thin but durable fabric. Noticed, too, how it kept changing the shape of its pseudo-hand to gain a better purchase. On a whim, Rhys lowered his own hand to where the bogdillo could see it and slowly, carefully peeled the corner back. He left his hand in plain view—the eyestalks took note. After a few permutations, the bogdillo had approximated a hand (albeit, without digits it looked like a hand in a sleek, shiny mitten) and had satisfactorily manipulated the thin folds. Rhys sat back in amazement.

In short order, the missing bogdillos returned and, after a very brief and bright consultation with their conferees, deposited an array of goods on the silty squelch of beach. Rhys heard a scanner's metallic purr to his right.

"Lord," said Godwin. "What a treasure trove."

The two arthropods in possession of the tarp made a show of removing it from the beach, then returned to gesture very pointedly at their own pile of offerings, now at Godwin's feet.

Rhys glanced at the acquisitions director. "Fair trade?" he asked.

"Oh, I'd say so."

"Then make a show of picking it up."

"Me? You want me to take part in this . . . negotiation?"

"It seems you may have started it. What could be more appropriate than for you to close it?"

Godwin bent and picked up an armful of ores and plant-stuffs. He stepped back a stride for good measure. The bogdillos seemed satisfied. They took their tarpaulin and departed, fireflies blazing. The lagoon returned to a deep green sort of twilight as the alien light receded further into the lake.

"Well," breathed Godwin. "That was something, wasn't it? Did I really start all that, do you think?"

"I'm pretty sure of it." Rhys chuckled. "When I think of all the clues we got—lakeside foliage turning up in relatively faraway places, bogdillo-shaped constructs, the simians tossing food at them. . . ." He trailed off, a strange expression flitting across his face.

"They were aping the bogdillo trading methods, you mean?"

Rhys nodded, his eyes apparently on some fourth dimension only he could see. "So it would seem. And

while we were being pleased with ourselves for all our neat efforts toward trade in the villages, what probably convinced the bogdillos to give us that first cache of goods was the cargo crew lobbing seed cones at them."

Yoshi waggled her palm torch. "Now they know we can harness light . . . just like they do." She grinned. "I guess that makes us bogdillos too."

"I'm willing to bet they'll suspend coming to any firm decision until they've known us longer, but *this*," said Rhys, "is where we step out, Mr. Godwin."

The Englishman did a double-take. "I beg pardon?"

"We have found you a sentient life-form. I will even recommend the experts necessary to continue working with them. But *they* will have to determine if the bogdillos can lay claim to the mineral resources of this planet on a scale necessary to cede them wholesale to Tanaka."

"Now wait just a moment. You've found a sentient, now you're supposed to recommend that I negotiate with them for Bog's resources."

"A sentient, yes, but I've not proven them to be the representatives of a civilization. All I've shown you is a race of clever natives, which you wish to deal with as necessary, or so you said. The Collective takes a dim view of people—or even major corporations—dealing with native populations according to expediency. This is a culture, Godwin. There is potential for trade, potential for communication. But are these people in a posi-

tion to barter away the mineral rights for their entire world? Would they even understand what they were bartering away? Until we know those things, we can do no more than deal with them on a purely local basis."

"Like this, you mean?" asked Godwin incredulously. "Beads and trinkets for ores and botanicals?"

"Not trinkets. An exchange of useful commodities. But yes, just like what we did here. A little at a time—while we establish communications . . . and search for other possible contacts."

"Ah. Other contacts which *could* negotiate mineral rights for Bog."

Rhys shook his head. "You're forgetting a fine point of Collective law, Mr. Godwin. If the bogdillos are not the only race of men on Bog, neither party would be allowed to barter away planetary resources. I believe you have jumped the gun. There is nothing here for you to acquire . . . yet. Only trinkets, as you call them."

Godwin, crushing his armful of ores to his chest, brought himself stiffly upright. "You sir, have forgotten who pays your salary. I intend to tender a full report to Corporate as soon as I return to headquarters. I'll call in the requisite experts—"

"I'll give you my recommendations."

Godwin opened his mouth to retort, but Rhys cut him off. "They'll get the quickest results, Godwin. Don't sabotage yourself out of dislike for me."

"Take me back to the base camp."

"With pleasure."

"He'll try to find a work-around, you know," said Yoshi, her eyes fol-

lowing the stiff column of Godwin's back. "He'll try to find a way to get more sooner."

"Of course he will," Rhys acknowledged. "But fortunately there are saner heads at Tanaka. And there are the laws of the Collective. Until he can prove the bogdillos have the knowledge and authority to negotiate for such vast resources, those laws will force Tanaka to be content with limited commodities—still worth having, if our advance surveys are any indication."

"Until?" Yoshi turned off her palm-torch, plunging them into moist darkness. "What if he never can prove it? What if the bogdillos are not world-aware enough to negotiate and no other sentients turn up?"

She could feel his smile even in the darkness. "Oh, I think there may be other sentients here, all right. And I'm not the only one who thinks so."

"I don't get you."

"The bogdillos provide water to at least three other species—species capable of community existence and lodge building. Species also capable of a high degree of mimicry. After all, we saw them throw things at the bogdillos, and we saw the bogdillos throw them back."

Yoshi sucked in a deep breath. "You think the bogdillos are trying to get the other species to barter?"

"Maybe it's that simple. Maybe it's not. Consider this: What if the bogdillos are trying to *teach* the other species barter? What if they're trying to help them take an evolutionary step?"

"Is that possible?" Her voice came out in an awed whisper.

"I don't know. I wasn't around

when our ancestors learned these things. But I do know this—Mr. Godwin will have to acquire someone else's resources."

"Rhys, do you hear yourself? It's not just Godwin. It's Tanaka Corp. Most employers take a very dim view of an employee who feels he'd scored a moral victory in keeping them *out* of a multibillion credit deal."

Rhys grimaced. "You're right. And one of these days I expect my scruples will catch up with me. Unless my conscience gets there first."

"Your conscience?" She shifted closer to him in the dark to peer up into his face. "What would you have to feel guilty about? You've always conducted yourself ethically. I should know. I've always been there."

He turned to look at her, realizing that she had, indeed, always been there. He could just see the pale moon of her face, the glitter of her eyes. "Have you ever wondered what it would be like," he asked, "not to serve a corporate master? To be a scientist, pure and simple?"

"I know what it's like. So do you. When we were on sabbatical—"

"Not just when we're on sabbatical, Yoshi. But every day. You saw what happened on this assignment. The same thing that always happens. We serve two masters—Tanaka and science, in that order. And sometimes, like *this* time, their aims are mutually opposed. Science doesn't care if it takes a century to establish meaningful contact with the denizens of Bog. Tanaka most certainly does. And that puts us in an untenable position."

"You've thought about resigning be-

fore." It was a bald statement of fact.

"Aye, but I don't recall discussing it with you."

He could see the flash of white as she smiled. "I know things."

"Ah, now don't go all inscrutable on me, Yosh. In this frame of mind, I don't think I can take it." He put his arm around her shoulders. "Come on. We'd best get Godwin back to his tidy corporate shuttle before he starts throwing things again. I'd be dreadfully embarrassed if he accidentally started another round of negotiations and us with nothing to trade."

"You do have to give him credit for that," Yoshi acknowledged as they picked their way back to the swamp buggy, leaving their torches dark in silent mutual consent.

"I do? Well, I suppose you're right.

After all, he's leaving. I can afford to be charitable."

"Aren't we leaving too? I thought you were going to recommend some experts to take the post."

Rhys scratched his cheek. "Yes, well. Actually, I thought I'd recommend us. After all, we're already here, aren't we? Godwin wants expediency—how much more expedient can you get? Besides, if what I think's going on here is going on here, I surely don't want to miss it."

"And your resignation?"

"Can wait. A wee bit longer."

They had reached the swamp buggy by now and could hear Godwin, already within, haranguing Rick Halfax about his superior's complete lack of company loyalty. Rhys sighed. *Well, perhaps a very wee bit.* ■

(Biolog continued from page 110)

Ian was offered the job of managing editor of *Artemis Magazine* and the publishing vice-presidency of the parent Lunar Resources Company.

Due out the end of the year, the new magazine is to help finance the project, whose object is to send missions to the Moon and build a financially self-supporting Moon base. Content is to be half near-term, hard SF and half space science. Occupied in setting up the magazine, Ian has less time for writing, but manages to write some each day before starting work.

A first *Analog* story, "Fermat's Legacy" in September 1992, was sold only after subject to the usual Stan Schmidt hawk-eyed, hard-nosed, no-nonsense review. Since Ian gave Fermat a wife, Stan asked, "Was he married?" On his

lunch break, Ian walked to the Public Library and returned with a photocopied biographical page noting that Fermat had married his cousin. The sale was made on the spot.

If Ian can help raise some 1.3 billion dollars, comparable to the cost of a deep-water oil rig, he will be the first SF editor to do more than send just men's minds to the Moon. Transporting people is a straightforward engineering problem. The hard part lies in the social engineering needed to build people into the project. In a scientifically knowledgeable editor with a degree in political science, and practical experience in an incredible number of organizations that couldn't be enumerated here, Greg Bennett found the prepared mind that chance favors so much. ■

David Brin
**AN EVER-
REDDENING
GLOW**

*A few words for those who think of space and
its resources as "infinite. . . ."*

Illustration by Vincent Di Fate

We were tooling along at four nines to c, relative to the Hercules cluster, when our captain came on the intercom to tell us we were being tailed.

The announcement interrupted my afternoon lecture on Basic Implosive Geometrodynamics, as I explained the principles behind the *Fulton's* star drive to youths who had been children when we boarded, eight subjective years ago.

"In ancient science fiction," I had just said, "you can read of many fanciful ways to cheat the limit of the speed of light. Some of these seemed theoretically possible, especially when we learned how to make microscopic singularities by borrowing and twisting spacetime. Unfortunately, wormholes have a nasty habit of crushing anything that enters them, down to the size of a Planck unit, and it would take a galaxy-sized mass to 'warp' space over interstellar distances. So we must propel ourselves along through normal space the old-fashioned way, by Newton's law of action and reaction . . . albeit in a manner our ancestors would never have dreamed."

I was about to go on and describe the physics of metric-surfing, when the captain's voice echoed through the ship.

"It appears we are being followed," he announced. *"Moreover, the vessel behind us is sending a signal, urging us to cut engines and let them come alongside."*

It was a microscopic ship that had been sent flashing to intercept us,

massing less than a microgram, pushed by a beam of intense light from a nearby star. The same light (thoroughly red-shifted) was what we had seen reflected in our rear-viewing mirrors, causing us to stop our BHG motors and coast, awaiting rendezvous.

Picture that strange meeting, amid the vast, yawning emptiness between two spiral arms, with all visible stars crammed by the Doppler effect into a narrow, brilliant hoop, blue along its forward rim and deep red in back. The *Fulton* was like a whale next to a floating wisp of plankton as we matched velocities. Our colony ship, filled with humans and other Earthlings, drifted alongside a gauzy, furled umbrella of ultra-sheer fabric. An umbrella that spoke.

"Thank you for acceding to our request," it said, after our computers established a linguistic link. *"I represent the Intergalactic Corps of Obligate Pragmatism."*

We had never heard of the institution, but the captain replied with aplomb.

"You don't say? And what can we do for you?"

"You can accommodate us by engaging in a discussion concerning your star drive."

"Yes? And what about our star drive?"

"It operates by the series-implosion of micro-singularities, which you create by borrowing space-time-metric, using principals of quantum uncertainty. Before this borrowed debit comes due, you allow the singularities to re-collapse behind you. This

creates a space-time ripple, a wake that propels you ahead without any need on your part to expend matter or energy."

I could not have summarized it better to my students.

"Yes?" The Captain asked succinctly. "So?"

"This drive enables you to travel swiftly, in relativistic terms, from star system to star system."

"It has proved rather useful. We use it quite extensively."

"Indeed, that is the problem," answered the wispy star probe. *"I have chased you across vast distances in order to ask you to stop."*

No wonder it had used such a strange method to catch up with us! The C.O.P. agent claimed that our BHG drive was immoral, unethical, and dangerous!

"There are alternatives," it stressed. *"You can travel as I do, pushed by intense beams cast from your point of origin. Naturally, in that case you would have to discard your corporeal bodies and go about as software entities. I contain about a million such passengers, and will happily make room for your ship's company, if you wish to take up the offer of a free ride."*

"No, thank you," the Captain demurred. "We like corporeality, and do not find your means of conveyance desirable or convenient."

"But it is ecologically and cosmologically sound! Your method, to the contrary, is polluting and harmful."

This caught our attention. Only folk who have sensitivity to environmental

concerns are allowed to colonize, lest we ruin the new planets we take under our care. This is not simply a matter of morality, but of self-interest, since our grandchildren will inherit the worlds we leave them.

Still, the star probe's statement confused us. This time, I replied for the crew.

"Polluting? All we do is implode temporary micro black holes behind us and surf ahead on the resulting recoil of borrowed space-time. What can be polluting about adding a little more space to empty space?"

"Consider," the C.O.P. probe urged. *"Each time you do this, you add to the net distance separating your origin from your destination!"*

"By a very small fraction," I conceded. "But meanwhile, we experience a powerful pseudo-acceleration, driving us forward nearly to the speed of light."

"That is very convenient for you, but what about the rest of us?"

"The . . . rest . . . the rest of whom?"

"The rest of the Universe!" the probe insisted, starting to sound petulant. *"While you speed ahead, you cause the distance from point A to point B to increase, making it marginally harder for the next voyager to make the same crossing."*

I laughed. "Marginally is right! It would take millions of ships . . . millions of millions . . . to begin to appreciably affect interstellar distances, which are already increasing anyway, due to the cosmological expansion—"

The star-probe cut in.

"And where do you think that expansion comes from?"

I admit that I stared at that moment, speechless, until at last I found my voice with a hoarse croak.

"What . . ." I swallowed. "What do you mean by that?"

The C.O.P.s have a mission. They speed around the galaxies—not just this one, but most of those we see in the sky—urging others to practice restraint. Beseeching the shortsighted to think about the future. To refrain from spoiling things for future generations.

They have been at it for a very, very long time.

"You're not having much success, are you?" I asked, after partly recovering from the shock.

"No, we are not," the probe answered, morosely. "Every passing eon, the Universe keeps getting larger. Stars get farther apart, making all the old means of travel less and less satisfying, and increasing the attraction of wasteful metric-surfing. It is so easy to do. Those who refrain are mostly, older, wiser species. The young seldom listen."

I looked around the communications dome of our fine vessel, thronging with the curious, with our children, spouses and loved ones—the many species of humanity and its friends who make up the vibrant culture of organic beings surging forth across this corner of the Galaxy. The C.O.P. was saying that we weren't alone in this vibrant enthusiasm to move, to explore, to travel swiftly and see what there is to see. To trade and share and colonize. To go!

In fact, it seemed we were quite typical.

"No," I replied, a little sympathetically this time. "I don't suppose they do."

The morality-probes keep trying to flag us down, using entreaties, arguments and threats to persuade us to stop. But the entreaties don't move us. The arguments don't persuade. And the threats are as empty as the gaps between galaxies.

After many more voyages, I have learned that these frail, gnat-like C.O.P.s are ubiquitous, persistent, and futile. Most ships simply ignore the flickering light in the mirror, dismissing it as just another phenomenon of relativistic space, like the starbow, or the ripples of expanding metric that throb each time we surge ahead on the exuberant wake of collapsing singularities.

I admit that I do see things a little differently, now. The universal expansion, that we had thought due to a "big bang" is, in fact, at least 50% exacerbated by vessels like ours, riding along on waves of pollution, filling space with more space, making things harder for generations to come.

It is hard for the mind to grasp—so many starships. So many that the Universe is changing, every day, year, and eon that we continue to go charging around, caring only about ourselves and our immediate gratification. Once upon a time, when everything was much closer, it might have been possible to make do with other forms of transportation. In those days, beings *could* have refrained. If they had, we might not

need the BHG drive today. If those earlier wastrels had shown some restraint.

On the other hand, I guess people will say the same thing about *us* in times to come, when stars and galaxies are barely visible to each other, separated by the vast gulfs that *we* of this era shortsightedly create.

Alas, it is hard to practice self-control when you are young, and so full of a will to see and do things as fast as possible. Besides, everyone *else* is do-

ing it. What difference will our measly contribution make to the mighty expansion of the Universe? It's not as if we'd help matters much, if we alone stopped.

Anyway, the engines hum so sweetly. It feels good to cruise along at the redline, spearing the starbow, pushing the speed limit all the way against the wall.

These days, we hardly glance in that mirror anymore . . . or pause to note the ever-reddening glow. ■

IN TIMES TO COME

One of the best ways to bring out a person's full potential is to coax, trick, or otherwise induce them to do something beyond what they think they can. You might, for example, drop a severely disabled person off in a desert wilderness with instructions to walk out. Sound cruel? Not necessarily. Already technology can do a lot to boost the abilities of a disabled person, and it won't be long before *that* potential reaches the level you'll see in W. R. Thompson's "Out of the Waste Land," our March cover story. "Waste Land," of course, can be either literal or figurative—but either way, it's often a mistake to believe you're stuck there. An ability that depends on artificial enhancements is no less real than one that doesn't. . . .

Thompson's novelette is nicely complemented by Robert A. Freitas, Jr.'s fact article, "The Future of Computers." It may sound like a fairly straightforward, even limited, topic—but bear in mind that computers have already permeated virtually all aspects of life, and those of even the near future may be wildly different from those of today. Which, in turn, implies that life will, too. . . .

We'll also have stories by Joseph H. Delaney, Pete D. Manison, and Marianne Dyson—and, of course, Part 2 of Charles Sheffield and Jerry Pournelle's *Higher Education*.

THE REFERENCE LIBRARY Tom Easton

Brightness Reef, David Brin, Bantam, \$22.95, 513 pp. (ISBN: 0-553-89015-6).

Other Nature, Stephanie A. Smith, TOR, \$21.95, 253 pp.

(ISBN: 0-312-85638-5).

Amnesia Moon, Jonathan Lethem, Harcourt Brace, \$20, 256 pp.

(ISBN: 0-15-100091-3).

Alien Rites, Lynn S. Hightower, Ace, \$4.99, 221 pp. (ISBN: 0-441-00219-6).

Life Form, Alan Dean Foster, Ace, \$5.99, 311 pp. (ISBN: 0-441-00218-8).

Darwin's Dangerous Idea: Evolution and the Meanings of Life, Daniel C. Dennett, Simon & Schuster, \$30, 589 pp. (ISBN: 0-684-80290-2).

With *Sundiver*, *Startide Rising*, and *The Uplift War*, David Brin created a future both with immense potential for fiction and with such sheer biological and historical *likeliness* that it is very easy to believe. The basic idea is simple: When a species becomes technologically capable of redesigning other species, it does so. Some of the new designs are just biological tools. Some, however, are nobler things, new intelligences, uplifted to stand beside their makers or "patrons" as at least potential equals. And from this flows an intergalactic culture in which species trace alliances and kinships to shared patrons, owe debts of service and wealth to those patrons, and recognize that even patrons once had patrons of their own, all the way back to the fabled Progenitors. The framework has lasted for billions of years, long enough for potential upliftees to become scarce and for new ones to be recognized as treasures, for a plan-

etary leasehold system to develop, and for it to be recognized that after times of settlement and exploitation, worlds must be vacated and left fallow for millions of years while their biospheres recover and—the system hopes—new potential upliftees evolve.

The earlier novels in the series recounted what happened when humans met this culture of patrons and uplifts: There was immediate antipathy, for humanity has no patron species. It is a wolfing, proud and fierce and not humble at all. The aliens, who refuse to believe that intelligence can evolve on its own, are extraordinarily condescending. Some insist that humans are an orphan species, abandoned by some unknown patron and thus properly taken under some elder species' wing (and of course made subservient). Some declare them anathema for flouting tradition (why, they have even done their own uplifting with

chimps and dolphins!) and call for their extermination.

The Uplift War showed humanity earning respect and a place among their elders. Yet that was no sure thing. At some point, a group of humans fled the scene, seeking a hiding place where the species might survive if the very worst came to pass. What they found was one of those fallow worlds, Jijo—but it was not untenanted. Six other species had snuck past the barriers, destroyed or sunk in the deep-sea Midden, a subduction trench, their high-tech devices, and settled in. Their reasons were varied, but all sought the Path of Redemption, a return to primitiveness, to pre-uplift status. Someday, they dreamed, they would be chosen for uplift once more, and then they would reclaim the stars. Meanwhile, they did their best to leave no lasting mark on Jijo, to let the following proceed as scheduled. They knew that if they were caught on Jijo, they would be judged as criminal “sooners.” Only by minimizing their damage might they hope to survive judgment.

Humans made the seventh dwarfed remnant of a galactic species on Jijo (should we pronounce that Hi-Ho? I wouldn't put the joke past Brin). They fitted in, though they had to fight wars before there could be forged a multispecies peace that has lasted to the time of the novel at hand, **Brightness Reef**. Jijo is now ruled by its sages of all species. People live together in harmony, valuing each other's unique abilities and qualities. It is a model in miniature of what the galactic culture should be but far too

often is not.

And now a starship streaks thunder-bellowing across the sky. The sooners have been discovered! Judgment is at hand! Destroy all our works! cry the traditionalists, that our judges can see our remorse. Wait! cry more reasoned voices, until the sages can speak.

The ship lands in the mountains, where sages and people have gathered to worship the Great Egg, a mysterious object that emerged from Jijo's molten depths a century before. Immediately it is obvious that it does not come from any legitimate galactic source, for it lacks the sigil of the Galactic Library. It is bandits, raiders, come to Jijo in search of treasure, valuable genes, ideally potential upliftees. And the Jijoans are not slow to realize that the villains can afford to leave no trace of their handiwork.

What to do? Well, here is a multi-species band of youths who are building a bathyscaphe, and a sage who has taken an interest, handing them upgrades for their equipment and telling them, “Once you're down there, look for a cable. Hook onto it, and then we'll haul it in, along with whatever high-tech cache our ancestors attached to it for this day of just-in-case.” Here is the man known as the Stranger, plucked naked from a swamp, brain-damaged, speechless, amnesiac, though Brin lets us watch his recovery of memory and realize he represents another force, perhaps opposed to the bandits. Here is Sarah, a mathematician who has turned her attention to linguistics and has some insights into the value of losing rigid, precise grammars in favor of chaos

(which permits more creativity).

And the Jijoans manage quite well without them, weathering their own conflicts and those induced by their scheming foes, and putting paid at least to the bandits' local representatives. Not one of them is essential to the resolution of this novel. Brin spends considerable effort on relating their stories, but the true hero of his novel is the multicultural society of Jijo. There are difficulties in the way of multicultural harmony, but this may well be where his vision has been heading all along.

Brightness Reef is the first volume of a new trilogy. Fortunately, Brin promises that we won't have to wait years for the next volume—it's due in 1996. I can hardly wait, for Brin has shown beyond doubt that he is a master of plot and character and incident, of sheer story-telling, while he is also thoughtful enough to satisfy anyone's craving for meat on those literary bones. Don't miss this one, folks. Or the next.

Stephanie A. Smith's first foray into SF (after the fantasies *Snow-Eyes* and *The Boy Who Was Thrown Away*) is a remarkably humane exercise in the psychology of collapse and survival that says some of the same things as *Brightness Reef* in a very different way.

In *Other Nature*'s future—a fairly straightforward worst-case extrapolation of our present, with no possibility of evacuation and fallowing of the Earth—the rain burns, there are no fish in the sea, birds are scarce, and humanity, afflicted by plagues and

toxins and birth defects, is crowded into urban deecees (decontamination centers, I think). A few people struggle for survival in the “dead-towns” beyond the deecees, where they raise a little food, pull seaweed from the ocean, dodge “trolls” (machines which roar across the countryside incinerating everything as they go) and search for whatever happiness there may be.

Smith does not give this bleak background quickly, for her focus is much less past than present. Her setting is the dead-town of Monkar. Her people have quite mundane concerns—meet Emily, whose mate Sean is about to leave in search of Linda, who was their wife until she decided to flee to the nearest deecce. Their friend Ed, who wanders the countryside, has reported seeing her alive; Sean is determined to bring her home. Emily is secretly relieved that Sean is leaving, for now perhaps she can spend more time with Maria. And perhaps she will stop waking to those strangely musical cries in the night that no one else hears.

Meet Tomas, one of Monkar's many “defective” children, deaf and nearly dumb; he loves to swim. Meet Nathaniel, who swears seals have reappeared along the shore and dreams of how much their meat and hide and oil might help Monkar through the next winter. Meet the rest, clinging to a precarious survival, their hope for the future resting in children they cannot help but consider broken, their mood a quiet despair.

Now glimpse the ruin that may once have been a lighthouse. When

the villagers explored it, they found it full of glassware and needles and other lab equipment, as well as drifts of paper marked with mysterious rows of letters (GACCTACTTTTTTCAGAGAG . . .). Sean is carrying a sample on his quest; with luck he will find someone who can say what it means.

Can you guess? I could, for there is a resonance here with myths of selkies and mermaids, and a modern biologist is necessarily prepared to see hints of salvation through change. Yet many people are unprepared to accept what does not fit their narrow definition of what is right and proper for their world, for their children, for themselves. This is what makes the deeces a disaster zone for those who venture there. It is what makes it difficult for Smith's characters to recognize what is happening all around them.

What are the deeces like? Smith does not take us there, giving us no more than fragments of memories and disasters. She remains resolutely in the wasted countryside, close to what is left of nature, as if to say that technology and civilization have become irrelevant. And perhaps they have, in her future. Perhaps indeed the answer to survival is to return to a kind of primitiveness, to let the world heal, and then—perhaps—to rise again.

If you remember *Gun, with Occasional Music* and its kangaroo gunsels and laws against knowing what you do for a living, you already know that Jonathan Lethem has a talent for the unlikely, the satiric, the intensely symbolic, and the just plain weird. It fits

far, far too well that the fellow lives in Cloud Cuckoo-Land, otherwise known as California. Or maybe he just took too many philosophy courses when he was a kid.

So what's his second novel, **Amnesia Moon**, like? Unlikely, satiric, intensely symbolic, and just plain weird. It opens in dusty, derelict Hatfork, Wyoming, where Chaos lives in the projection booth of a decaying movie theater. When he goes to the local store, we learn that food is scarce and children—like furry little Melinda—are mutants. It seems that there was a nuclear war a few years before. Hatfork and the neighboring town of Little America, where Kellogg lives and dispenses food, are all that's left.

Does it sound a bit hackneyed so far? It did to me, too, but I kept reading and I learned what Lethem can do with a snail cliché. When Chaos and Melinda go to Little America in search of food, we learn that all is not what it seems. The local world is the product of Kellogg's dreaming, and Kellogg insists that Chaos is just as capable as he of making a world. (Is a dream-maker from Hatfork a nod to a certain Maker from Hatrack? Why not.)

Chaos and Kellogg fight, and Chaos and Melinda hit the road in search of someplace better. As soon as they are out of range of Kellogg's dreaming, Chaos dreams of a time when he was called Everett, lived in a little house with a talking computer, and loved a woman called Gwen. Is this the past? It seems so, but it is quite out of reach, and now they are driving up a mountain, the air is turning green and opaque, and his name is Moon.

What's going on? They have entered the realm of another dreamer, where reality takes on a very different hue. Later, in Vacaville, they will find still another such realm, where people move twice a week and are ruled by "luck" while worshipping government "stars." They will hear of a war against alien hive-monsters down Los Angeles way. Clearly, the world has fragmented, broken into a myriad of what one character calls Finite Subjective Realities or FSRs. We can recognize a kind of solipsism intermediate between "the whole universe is the figment of one imagination" and "every imagination creates its own reality."

Where is Lethem going with this? In Vacaville, Chaos-Everett-Moon finds Edie, a woman with two kids, an ex, and an importunate bureaucrat. He is also summoned home to San Francisco by an old friend who homes in on his dreams. Once there, he finds still more strangeness, pressure to use his dreaming power to shape the world to a schemer's specifications, insight into FSRs, and finally a solution—albeit a temporary, partial, local solution.

Perhaps what Lethem is really up to here is a consideration of how, if solipsism is real and there are multiple realities, one can choose among all those realities. His answer is that in the best of worlds, one welcomes others as independent entities with wills and needs of their own. One does not force them into predefined roles and allow them to exist only as answers to one's own needs.

He *almost* says as much, but his

taste is for the symbolic, not the explicit. He leaves it to us to figure out what he means, and I may well be wrong.

Alien Rites is the fourth in Lynn S. Hightower's interesting series about an Earth to which have come the alien Elaki, shaped something like erect manta rays, quite intrigued by things human (teddy bears are *big* on the Elaki curio market), and eager to fit in despite a certain snootiness. Indeed, one of them, named String, is a detective on the local police force, partner to David Silver, who has on his hands a smashed-up, blood-stained luxury car whose owner—Luke Cochran, a supposedly impoverished college student—is missing. The car was abandoned, rather the worse for wear, on the edge of Elaki-Town, a district occupied by lower-class Elaki. When interviewed, the car says that at the time of the accident, it held Luke, three Elakis, and a woman who was crawling from the trunk into the back seat and flailing away with a tire iron.

To one side stand Annie Trey, a poor girl whom the press have accused of poisoning her baby, and her wheezing, coughing toddler. It was Annie who called in the accident. Now it is a dark and rainy night, and Elaki-Town is ominously silent and watchful. What's worse, says String, that strange bell-like sound is the cry of a trillogy, a predator from the Elaki homeworld, and it is *not* supposed to be here.

Silver, moved by thoughts of his own daughters and of a wife who throws crockery every time he comes

through the door, sends Annie and her child home. A little later, he finds a teddy bear, concludes it must be the child's, and takes it to Annie's slum apartment, where all the best furniture is painted on the wall. Not long after that, he too is coughing and wheezing, suffering from aches and fevers, feeling as if death might actually be a relief.

Silver's brother, Mel, is upset because his girlfriend, Miriam, has gone missing. She was working on the case of Annie Trey's dead baby, trying to figure why it died. And now Hightower's elements are all in place. It is up to her characters to carry out the necessary investigation, to discover what happened to Miriam and Luke, who the woman in the trunk was, what part teddy bears play in it all, and why the trillogy is far less dangerous as a predator than as a vehicle.

Hightower has created a fascinating collision of cultures in this series. The Elaki are strange but quite real enough to accept, and their differences from humanity give rise convincingly to the complications of her plot. Better yet, that plot—and Hightower's storytelling—seem much improved from the first book in the series (*Alien Blues*), which I reviewed in July 1992.

Keep an eye on this writer, and don't miss her next.

Alan Dean Foster has a reputation for light, jaunty, clever yarns with—sometimes—a bit of thematic meat on their bones. However, his recent titles can seem clever only to those with little familiarity with book, film, or TV. Their jauntiness is strained. All that is

left is a lightness indistinguishable from inconsequentiality.

My case in point is his latest, **Life Form**. Its first quarter is a pedestrian account of the arrival of a crew of scientists on Xica, the first alien world to be found with a well-developed biosphere. They get out of their ship. They set up camp. They collect specimens. They find intelligent aliens and begin to learn their language. They get a hint that there is something mysterious about the local lifeforms.

The nature of the mystery is clear to the reader long before the characters catch on. It is also unlikely enough to strain whatever remains of one's willing suspension of disbelief. And when the characters finally get it in the neck, one almost stands up and cheers. They are that wooden, uninteresting, and unsympathetic.

If I gave out stars, I wouldn't.

Daniel C. Dennett is a Tufts University philosopher (currently director of Tuft's Center for Cognitive Studies) with a record of writing thoughtful, provocative essays and books (some of the essays even look a bit like SF). Yet nowhere can he possibly have been more provocative than in his latest, **Darwin's Dangerous Idea: Evolution and the Meanings of Life**.

The debate over the Darwinian view has been going on for almost a century and a half. In that time, Darwin's basic scheme has accreted layer after layer of detail, interpretation, extension, and even demonstration (drug resistance in bacteria and pesticide resistance in insects are clear examples of natural selection) until one

might expect that today no one could possibly resist it. Of course, many do. As Dennett notes, some of the "many" are even among the scientific camp, where they search desperately for what he calls "skyhooks," logically essential appeals to the supernatural. He includes in this group Stephen Jay Gould, an evolutionary biologist famous for his criticisms of "no skyhooks" Darwinism, and spends a great deal of time deflating him.

What does "no skyhooks" mean? Dennett says that "Darwin's idea [bears] an unmistakable resemblance to universal acid: it eats through just about every traditional concept, and leaves in its wake a revolutionized world view, with most of the old landmarks still recognizable, but transformed in fundamental ways." Natural selection is an algorithm for moving through the Library of Mendel, a variant on Borges's Library of Babel, or—more broadly—"Design Space." And its most revolutionary aspect may be that there is nothing essentially biological about it. It is an essence of pragmatism that—despite how badly it upsets supernaturalists—does indeed yield sophisticated design, intelligence, and intention from sheer mechanical randomness ("... if Darwin is right, your great-great ... grandmother *was* a robot!"). He is only half facetious when at one point he refers to Darwin as "St. Charles."

Many object to Darwin as the essence of soulless materialism. Accept it, they say, and spirit flies out the window, and with it go morality, ethics, loyalty, and any sense of a higher being to whom we owe thanks, obedience,

fear, awe, or worship. Dennett replies that "Darwinian thinking helps us see why the traditional hope of solving [moral] problems ... is forlorn. We must cast off the myths that make these old-fashioned solutions seem inevitable. We need to grow up, in other words." What should we do with religion? "Safety demands that religions be put in cages [as lions are in zoos]—when absolutely necessary. ... If your religion advocates slavery, or mutilation of women, or infanticide, or puts a price on Salman Rushdie's head because he has insulted it, then your religion has a feature that cannot be respected. It endangers us all."

We all tend to approve of books that confirm our personal biases. This one does that for me, and I suspect it will do the same for many *Analog* readers, who have for many years been exposed to editorials, articles, and stories that favor the rational, unsentimental, antisupernatural approach to reality (for a classic instance, think of Tom Godwin's 1951 "The Cold Equations"). Why should you take the time to wade through it, then? Dennett lays out a great deal of evidence from many fields as he develops his position, and if you pay attention, he will elevate your bias to the level of knowledge.

It probably wouldn't be worth the effort to give copies to your favorite creationists (unless you like to see them sputter), but I think this one should be considered required reading for anyone who hopes to be an educated person. You would surely serve the next generation very well to ask your local librarians—town and school—to get copies. ■

BRASS TACKS

Dear Dr. Schmidt,
I thought I would add my voice to Marian Powell's (May 1995 Brass Tacks). I, too, am a second generation *Analog* reader. In fact I remember clearly the first time I read one: I stole my father's copy off a coffee table. It had a beautiful cover picture of a spaceship, leaving a trail of Mach diamonds (inaccurately, as a later letter pointed out) and the lead story was "The Artefact," [sic] about alien contact. Unfortunately I lent the copy to a friend who lost it, but it would have been around the late sixties. It's impossible to describe just how bowled over I was by it. I had never ever in my life read anything like *Analog*. There was a hard edge to the stories that I loved even though I could barely follow some of the specialized vocabulary—what, for heaven's sake, was a hyperdrive? Miss Witcher my physics teacher, splendid woman though she was, couldn't help me.

It didn't matter. I simply picked it up as I went along. Then I discovered what amounted to an *Analog*-mine in one of our store cupboards—my father's collection reaching into the mists of the fifties before I was even born. I stole them, a few at a time, and hid them behind other books in my room. Why I thought he would stop me, I don't know, only it seemed

to me at the time that such deliciously grown up and exciting stuff *must* be contraband.

Of course I read all the other magazines my father had collected, like *As-tounding* (Wow! *Analog*'s daddy!) and *New Worlds*, but I stayed basically loyal to my first love.

Ecstasy came with *Star Trek* on British TV. Not only did I know exactly what Mr. Spock and Scotty were talking about, there were articles about it in one of the *Analogs*. I became The School Authority on *Star Trek* and interstellar travel to a class full of Kirk/Spock worshipping girls. Even the wonderful Miss Witcher was a little fazed when I demanded that she explain relativity, special and general, in a single 40 minute lesson, without using formulae. Bless her heart, she did give it a blast.

Although like Ms. Powell I went off *Analog* in the '70s and found Ben Bova's editorial style dull, I carried on reading SF. Future shock has never happened to me because although specifics like the microchip and AIDS were not predicted, generalities like powerful computers that were quite small (e.g. tricorders) or plagues were often dealt with. I knew what computers would look like and what they might do.

No, I didn't become a scientist or an engineer, mainly because my math

wasn't good enough. I became a historian and a novelist instead. But I regularly read mainstream science periodicals. I'm still working on my math and will one day take a second degree in a science. I doubt any of this would have occurred to me without SF and *Analog* itself.

For the future, I have two comments to make on the quality of fiction in your pages. Firstly, I agree with Ms. Powell that too much of it is unimaginative and preachy, with clichéd characters. You yourself have commented sadly on the habit a lot of writers fall into of setting up Bad People with Obviously Wrong Ideas, the better to knock them down. However, seen from this side of the Atlantic there is another, much deeper and subtler flaw in the science fiction you publish.

Perhaps I can sum it up best by quoting—specifically from p. 71 of the May '95 edition. Nice map, the Earth as seen from above the midpoint of the USA. North and South America both there, couple of squiggles off to the left indicating the easternmost end of Asia and Japan. Now this is not a criticism of G. Harry Stine's article which is, as his work usually is, lucid, sensible, visionary, and intelligent. Other maps show the great circle routes across all of the world and pinpoint the hub-points.

However, I get the feeling that the map on p. 71 is what the whole world looks like for far too many of your writers. Eurasia, India, Africa, Australia? Oh yes, vague trouble spots, inhabited by either 1) people who think and act exactly like Americans but (in-

explicitly) talk funny or 2) incomprehensible, probably evil, aliens.

Now when I started reading *Analog*, one of the things I found strangest was the stomping Yankeeism of it all. Everybody was either a good ole boy or a clipped-talking technocrat. I accepted it uncritically and only gradually noticed that different shades of people were either absent or irrelevant. Women were ignored, patronized, or occasionally (and thrillingly) had the same expectations and responsibilities as men. All these things, except the insularity, have gradually improved—often they improved in your pages first in the world—and I'm glad to see that *Analog* is still in there punching against the gray plague of PCness. I also liked Campbell's very American idealism, the idea that SF and *Analog* itself had a wider duty than solely to sell lots of copies.

However, the way your writers assume that in the future everyone will speak American or will be called John and Ted or that the American Way will triumph over the whole globe—surely this is naïve? I know you're an American publication designed for an American market, but at the very least, more science fiction writers could speculate. Is the USA *really* likely to be the top technical nation in the 21st century? I don't think so, not if Americans in general carry on in the complacent, litigious, anti-knowledge way they're going at the moment. Don't get me wrong, I was brought up to be pro-American, and like you chaps enough to have married one. Yes, I have been over to see for myself and was shocked by how incredibly

car-dependent everybody is compared with Europeans. Yes, you have Bill Gates. But you also have the Bakkers, far too many lawyers, and you are *still* arguing the toss over Darwinism. Yes, you went to the Moon. Been back recently? Seen from over here, the USA is a vast young creative giant, rather plump from the fruits of previous genius, and settling down for another good long snooze.

So, on current form, top techno-nation next century is probably going to be Japan or China. What effect is that going to have on Americans? Speaking as a member of a nation that was top dog in the last century and isn't anymore, I can categorically state that the effect is enormous and totally unpredictable, which makes it ideal for SF writers to get their teeth into. It doesn't have to be downbeat. Maybe that will get you guys off planet—if you're second best, maybe you'll try harder (unlike us nostalgia-hypnotised Brits.)

Is this all too complicated for your writers? It isn't for your readers. Do your writers really think there are only two continents on the Earth—the American one and South America? If the readership can't cope with a spot of radical prediction and internationalism, what hope is there for the rest?

But, I still subscribe to *Analog*, and every time I start to think seriously about canceling—usually after a couple of issues overloaded with stories in which nanomachines turn out to be the *dei ex machina* in the beautiful American future—something turns up like that wonderful story "In Forests Afloat Upon the Sea" by Daniel Hatch, which changes my mind.

So wake up, smell the powder, take some risks. That way, when my own daughter is nine, I, too, can casually leave an *Analog* out on a table somewhere and enjoy watching her mind being stretched as mine was.

PATRICIA FINNEY

Cornwall, UK

Dear Mr. Schmidt:

I'm afraid that I must take exception with Mr. Stine's "Alternate View: Beauty and the Beasts" (May 1995). For someone like Stine to claim to be an art authority of any degree and to know all of the philosophies that guide and constrain the creation and appreciation of art, a subject that the greatest minds throughout history do not agree on, is gross presumption. For him to claim that those whose tastes in art differ greatly from his own have been coerced into believing that they enjoy something that they are genetically incapable of enjoying is both arrogant and illogical.

In the first place, not all definitions of art—definitions, not just by artists and art critics, but by philosophers such as Plato, Aristotle, and Bacon—include the necessity of communicating beauty to the observer, or communicating with the observer at all, for that matter. For Stine to argue that we might compel art to be beautiful in the same article in which he inveighs against artistic foundations based on "coercive power" is not only hypocritical, but denigrates many of those species-wide commonalities that he champions so vigorously, such as creativity and acquisitiveness. Human beings are driven to create regardless of

whether or not a market for their creations exists; and, though Freud's sublimation theory may be challenged by modern psychological theory, the therapeutic benefit of artistic expression is unrivaled by almost any other form of non-chemical therapy. Human beings are also driven to collect, and the only requisite for inclusion in a collection is that the collected item be, in some way, interesting. (Indeed, one may even argue that interest, itself, is a form of beauty.)

In the second place, even if we accept that works of man must be beautiful to qualify for the appellation, art, just about any normal pop-music-loving teenager with normal parents, who are not stone-deaf, will readily accept David Hume's assertion that the beauty of a thing rests in the mind that contemplates it. Of course, the prime tenet of Stine's article is not that beauty is not in the eye of the beholder, but that the structure of the human mind is too uniform across the entire species to allow for the scope of artistic taste that his professors tried, unsuccessfully, to reveal to him. His own arguments, however, refute his thesis.

Take his explanation of the neurochemistry of aesthetics—which is overly simplistic, at best. Many of the patterns which our basic neurochemistry “rewards” us for recognizing and creating are, if not entirely the results of past experiences, then at least greatly affected by them; thus, even if we accept that we have some specifically innate patterns which all humans agree are beautiful, we each still collect, as we grow and accumulate a

unique set of experiences, a unique set of patterns that evoke memories and feelings, and that we alone may recognize as being beautiful, and some of which may not be entirely natural, despite Stine's insistence that the natural Universe is beauty absolute. (I ought to point out, here, that forest fires and mudslides are natural phenomena; and though some might find a stark beauty in the charred remains of a burnt forest or in the intricate erosion patterns of a mudslide, many of us find these sights, natural though they are, to be unattractive.)

Take, also, his example of automobile designers, manufacturers, and dealers. How many of these common man's art critics would argue that the once-popular styling of the Studebaker would likely be a runaway marketing success if it were to be revived today? How does Mr. Stine explain this change in aesthetic taste in automobile styles, if not by cultural metamorphosis from a *Spirit-of-St.-Louis* to a jet-fighter society? Or, is it possible that the human central nervous system has evolved so radically in half a century?

Probably the most common error in describing the mind of man is to assume either that it has some supernatural quality that cannot be explained in physical terms, or that it is really not much more complicated than a desktop computer. It is more likely that, while the human mind may be no more than the sum of all its parts, those parts are so innumerable and their interrelationships are so complex and variable that we might never

be able to understand them completely or reproduce them artificially (though I would not entirely rule out either possibility). One thing is almost certain: although the coarse structure of man's psyche may be as common to the species as the structure of his hand, the detailed structure is as individual as his fingerprint; and nowhere is this individuality more evident than in aesthetic preference. There really is (and likely always will be) no accounting for taste.

I don't like much modern art; nor do I advocate taxpayer support for artists whose works are generally reviled by the public, or display of said artwork in a prominent, exposed, public location. But, I would never be so egocentric nor so chauvinistic as to claim that it can't be art because I don't enjoy it, or that no one else could possibly enjoy it if I don't; perhaps G. Harry Stine could benefit from my example.

PERRY MILLER

Bremerton, WA

The author replies. . .

Dear Stan,

I fully expected to hear from the revisionary relativists following the publication of my Alternate View column, "Beauty and the Beasts." However, I didn't believe it possible that I would receive such a classic retort as Perry Miller's letter. If anything confirms the reality about which I wrote, it's that letter!

Miller's attack follows the well-hearsed rules of the revisionary relativists. He questions why I consider myself to be an "art authority." I never

said I was. However, I listed some of my qualifications. Therefore, I ask, "What are *your* qualifications, Mister Miller? You didn't bother to reveal them."

He continues to whine the liturgy of the relativists: "Beauty is in the eye of the beholder. It is because I say it is." Of course, wishing makes it true. All you have to do is to wish upon a star and remember that a dream is a wish your heart makes. Wishing will always make it so, right? He is perhaps unconsciously and without thinking basing his entire response on the basic credo of the relativists that derives from the tenets of 19th century materialism. This was expressed by Aleksandr Solzhenitsyn in "How the Cult of Novelty Wrecked the 20th Century:" *"There is no God, there is no truth, the universe is chaotic, all is relative. How clangorous it all is, but also—how hopeless."*

Just because something has become obsolete doesn't mean that it's no longer beautiful. How about the clipper ship *Flying Cloud*? The Ryan NYP *Spirit of St. Louis* is as beautiful today as when it first flew. So is the lumbering old DC-3. I wish I still had my 1952 Studebaker Starlight Coupe because Raymond Loewy's design was beautiful then and remains beautiful today. So are his shroud treatments for the Baldwin Hudson steam locomotives that pulled the "Twentieth Century Limited" in the 1930 decade. (On the other hand, beauty is not why people collect Edsels.)

Chauvinistic? Egocentric? *Moi*? It is to laugh. Check the dictionary for the meanings of those words.

Beyond Miller's comments, however, lies a more serious issue that was alluded to in the column—but apparently he didn't get it. In 1870, the German poet Friedrich von Schiller examined the idea of democracy and the duties of citizenship in a free society. "Art is the daughter of Freedom. . . . If man is ever to solve the problem of politics in practice, he will have to approach it through the problem of the aesthetic because it is only through Beauty that man makes his way to Freedom." If we reject aesthetic and cognitive principles, we isolate our culture from an artistic heritage embraced by every culture since Paleolithic man first drew on cave walls. And if excellence is relative and really doesn't matter, then Athens and Florence are full of mediocrities. Mozart becomes elevator music for royal salons. And we have no basis for evaluating the atrocities of Buchenwald, Rwanda, or Oklahoma City.

Solzhenitsyn's article quoted above—it appeared in the Spring 1993 issue of *American Arts Quarterly*—carries this further as well as amplifying what I wrote. He observes that in this century the equilibrium between tradition and the search for the new took on a different goal: the destruction of centuries-old cultural tradition to disrupt the natural flow of artistic development and allow an unfettered great leap forward. It probably would not have succeeded at all without the most physically destructive revolution of this century that broke out in the streets of Petrograd in 1917. Having lost that revolution after some 75 years, Russians now find themselves

in shock because they have been cut off from the major flow of development. Most Russians now are saying that, yes, Communist doctrines were great lies, but absolute truths don't exist anyhow and trying to find them is pointless. Nor is it worth the trouble to find some kind of higher meaning to our lives.

I'm delighted that Perry Miller wrote his letter. It's a perfect example of the position, excuses, and irrationality of which I wrote. I could not feel more vindicated. It seems I gored Mister Miller's ox deep and panicked his herd of sacred cows as well. Basically, he's very upset that someone told him his emperor is running around stark naked. And wintertime is upon him.

G. HARRY STINE

Stan,

"What's Good for the Goose. . .," editorial, May 1995.

You are not the first to pose the question, "Why are people so stupid?" Most of us have expressed similar thoughts at one time or another, possibly starting around age five. . . .

Pointing to examples of stupidity is easy, and may be fun, but wouldn't it be more useful to invite suggestions as to what might be done to correct such situations?

I offer a possible explanation; we set up our government agencies and instrumentalities based on the idea that everyone is stupid, and therefore we must spell out in the rules and regulations the proper course to take in any contingency. This effort is doomed to failure, as not everything is foreseen.

able. An interesting news item on a similar vein in yesterday's papers—Florida's governor is proposing to scrap a few million words of detailed regulations and give the state bureaucrats a little leeway to use their own judgment. (Who knows, can it fail to be an improvement?)

Perhaps you could give us a "part two" on this subject, outlining approaches to overcoming some of these stupidities and, most important, methods for determining whether a given experimental approach is working.

Don't stop now!

WARREN RAYLE

Olmstead Twp., OH

Dear Stan,

Your editorial, "What's Good for the Goose. . .," (May 1995) ends with a profound insight that might be overlooked or considered in only its limited context. You say, speaking of medications, "What we need is to be able to find a solution that works for each of as many people as possible. . . ."

The widespread use of the words for everybody and for all when it would be both more accurate and significantly more effective to say for each is the symptom of a pervasive problem in pharmacology, politics, education, and many other contexts.

For example, you can read not only in the press (which has never coped well with degrees of truth) but in the professional literature such assertions as, "All students at this level should be able to. . . ." Statements like that are habitual to have exceptions, or probabilities, perhaps even distributed

along a bell curve.

E.g., only when educators are persuaded to revise their thinking and say, "Each student at this level should. . .," will they become committed to facilitating every single individual's achieving his or her full educational and economic potential.

We Americans suppose ourselves to differ from others largely in preferences, rights, etc. Yet we persist in using words like "all" and "every" that cloud our thinking. Such portmanteau terms divert our concern for individuals to a broader and more ambiguous concern for groups or even masses.

Your ". . . find a solution that works for each of as many people as possible. . . ." is probably the wisest and more practical goal, and maybe in the best of all possible worlds that's the best we might ever achieve. Yet, I fear we won't get even that far if that's the limited goal we seek. To get there, we'll have to shoot higher. The ultimate target is to ". . . find a solution, or solutions, that work for each individual."

Impossible? No, only very, very difficult. Of course, if we decide it's impossible, we're off the hook about striving for it.

FRANCIS CARTIER

Dear Dr. Schmidt:

Your editorial in the May 1995 *Analog* was an excellent discussion of certain ideas very familiar to those of us who practice medicine. Physicians are all too aware that the best available treatments have, prospectively, only a probability and not a certainty of success; that they may actually

cause harmful effects in a certain percentage of patients; and that the response to these treatments (or even whether they are appropriate at all) in an individual patient must be constantly reassessed. A prime goal of medical research is to develop new therapies with better overall "risk/benefit" ratios than those we have now.

However, I have grave reservations concerning your proposal to "use placebo first" in treating patients. As you correctly point out, to be psychologically effective, such a procedure would involve a physician "tricking" a patient, being dishonest with them—in short, violating their trust. The highly dubious ethics (to say nothing of the legality!) of such an action, even if ostensibly done "for the patient's own good," should be enough to preclude its routine use.

Another serious objection is that even if one ignored the question of its ethics, your proposal would be even potentially applicable to only a limited number of different types of medical problems. Significant placebo effects during treatment are most relevant to those conditions which involve pain and other symptoms which have a large subjective component. For common, minor problems like colds, mild musculoskeletal pain, hemorrhoids, etc. for a variety of "over the counter" medications are available and whose effectiveness may in fact be largely (if not almost exclusively) due to placebo effects, patients are free to go to any pharmacy and decide for themselves whether they wish to try any of them. If asked, I would give

them an honest appraisal (based on the current medical literature) as to how clinically effective and safe these medications are known to be, give my recommendations—and then the patient can make their own decision whether to buy them.

Conversely, there are many more types of medical problems in which the success of treatment is based primarily on much more objective criteria, or which involve the long-term *prevention* of serious complications. For example, even excluding those situations involving "imminent danger," as a cardiologist I would be hard pressed to think of any conditions I treat in which applying your proposal would not constitute gross malpractice. A critical goal in treating hypertension, coronary artery disease, or congestive heart failure is to reduce the increased risk of stroke, myocardial infarction, increased mortality, etc. associated with the "natural history" of these diseases over the course of many months or years. For all of these problems, medications and other treatments exist which, while not 100% effective or safe, have been shown in well-designed clinical studies to be, statistically, significantly more effective than placebo or "doing nothing," and for which a "scientific" physiological rationale for their effectiveness exists. Needless to say, the results of a treatment failure if placebo were "tried first" may be severe and irreversible, with death being the ultimate example. Safe, nonpharmacological therapy (e.g. dietary modifications, exercise, or smoking cessation) may also be effective "first-line" or supple-

mental treatment for these conditions, but use of a placebo for these types of measures would not be practical.

In some cases, in fact, placebo effects may be detrimental. The individual having an acute myocardial infarction who treats the "heartburn" they believe they are having with an antacid may actually get some relief of their pain due to a placebo effect. However, if this results in their delaying or not seeking medical attention, a catastrophe that could have been avoided may occur. Just because a

person is feeling better does not necessarily mean that they *are* better.

In short, any medications or treatments a physician prescribes should not only meet the standards of being as safe and effective as possible in as many patients as possible, but also have some chance of working independent of a placebo effect. Except, perhaps, in desperate situations where no more potentially effective treatments were available, the use of placebo by a physician as routine initial therapy cannot be justified.

HENRY G. STRATMANN, M.D. ■

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Carla Graubard
President and Publisher

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UPCOMING EVENTS Anthony Lewis

2-4 February

CREMECON 2 (Wisconsin SF conference) at Manchester East Hotel & Suites, Glendale WI. Author Guest of Honor—Lawrence Watt-Evans; Editor Guest of Honor—Sue Weinlein; Artist Guest of Honor—C. H. Burnett; Fan Guest of Honor—Richard Russell. Registration: \$20 until 4 January, \$30 at the door. Info: CremeCon 2, Box 37086, Milwaukee WI 53237; include S.A.S.E. (414) 223-3243. cremecon@aol.com

16-18 February

BOSKONE 33 (New England Regional SF conference) at Sheraton Tara, Framingham, MA. Guest of Honor—Lois McMaster Bujold; Official Artist—Gary Ruddell; Special Guest—Bob Madle. Registration: \$33 in advance. Info: Boskone 33, c/o NESFA, Box 809, Framingham MA 01701-0203. (617) 625-2311. CompuServe: SciFi Forum, Section 16. GENie: SFRT3, Cat 22, Top 15. Internet: boskone@nesfa.org Home page <http://www.panix.com/NESFA/home.html>

15-17 March

LUNACON '96 (New York City area SF conference) at Rye Town Hilton, Rye Brook, NY. Guests of Honor—Terry Prachett, Esther Friesner; Visual Humor Guest of Honor—Phil Foglio; Fan Guest of Honor—Bruce Pelz; Origami Guest of Honor—Mark

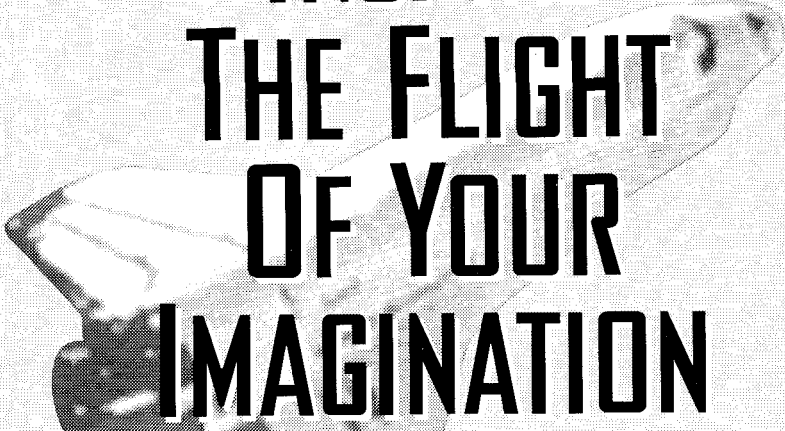
Kennedy. Registration: \$33 until 15 February, higher at the door. Lunacon '96, Box 3566, New York, NY 10008. lunacon@lunacon.org

29 August-2 September

L.A.CON III (54th World Science Fiction Convention) at Convention Center, Hilton, and Marriott Hotels, Anaheim, CA. Guest of Honor—James White; Media Guest of Honor—Roger Corman; Fan Guests of Honor—Takumi and Sachiko Shibano; Special Guest—Elsie Wollheim; TM—Connie Willis. Registration: \$90 until 30 June, \$110 until 31 December 1995, then higher. Child-in-tow (3-12 in 1996): \$35, infants: free, Supporting: \$30. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: L.A.Con III, c/o SCIFI, Box 8442, Van Nuys, CA 91409. lacon3-info@netcom.com

December is always a slow time for conventions as the holidays draw near. Let me join the rest of the *Analog* staff in wishing you all the best.

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